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HEAT CAPACITY MAPPING RADIOMETER

FINAL Report REPRO

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HEAT CAPACITY MAPPING RADIOMETER
FOR
AEM SPACECRAFT

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ITT Aerospace/Optical Division

Fort Wayne, Indiana 46803

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Final Engineering Report

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16. Abstract

The purpose of this report is to provide information necessary for the HCMR operation, maintenance and integration.

It provides block diagrams and detail schematics with description of circuit functions.

The electrical description includes data format and logic timing diagrams.

Mechanical and electrical configuration is included to provide mechanical and electrical interface details for integration of the HCMR instrument to AEM Spacecraft.

The radiometric and electronic calibration data is also included.

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PREFACE

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1.0 SYSTEM DESCRIPTION

The Heat Capacity Mapping Radiometer (HCMR) is designed to monitor infrared radiation from the earth in two spectral bands and from these measurements infer the following information:

- Nature and Type of surface Mineral Composition
- Thermal maps of earth and sea surface
- Temperature Gradient Maps

The HCMR is a two channel scanning/imaging radiometer. The two channels monitor the spectral intervals of 0.55 to 1.1 microns and 10.5 to 12.5 microns. Both channels have a common collecting optical system having an instantaneous field of view of 0.83 $\pm$ .17 milliradians.

The HCMR is comprised of four major subassemblies mounted in a common housing. These subassemblies are scan mirror and drive, optics, electronics and radiant cooler. The scan mirror drive assembly provides cross-course scanning of the instantaneous field of view with reference to the subsatellite ground track. The optical subassembly provides energy collection, concentration, focus and spectral definition of the two channels. The electronics subassembly contains the data amplifiers and housekeeping telemetry and formats the analog sensor data such that it is compatible with the HCMR data system. The radiant cooler subassembly provides detector operating temperatures of approximately 115° Kelvin (K). Table 1-1 lists the pertinent HCMR Design parameters, performance characteristics and physical characteristics.

1.1 Scan Drive Subassembly

The scanner design uses an elliptically shaped plane mirror set at 45° to the scan axis which rotates at 840 rpm. The scan mirror is fabricated from beryllium and is kanogen coated. The mirror is driven by an 80 pole Schaeffer motor which is synchronized to the spacecraft 560 Hz two phase clock. Angular momentum compensation of the scan mirror is provided by a separate motor driving a compensation mass. Scan mirror position is monitored once each revolution by redundant magnetic pick-ups.

1.2 Optics Subassembly

The optical subassembly is catadioptric collecting with an afocal reflecting telescope and focusing with refractive elements at the detectors. The collecting telescope is a modified Dall-Kirkham configuration which reduces the optical beam from an 8-inch diameter to a 1-inch diameter. The beam is then split into two components using a dichroic beam splitter. The two beams are focused onto the detectors using germanium lenses in the IR channel and glass lenses in the near IR channel.

A summary of the pertinent optical characteristics follows.

TABLE 1-1
HCMR SYSTEM CHARACTERISTICS

DESIGN PARAMETERS	NOMINAL VALUE
Wavelength Band @ half power points (microns)	0.55 to 1.1 10.5 to 12.5
Field of View (milliradians)	0.83
Ground Resolution (subsatellite point at 600 Km) (Km)	0.5
Optical Speed	f/.82
Collecting Aperture Diameter (inches)	8.0
Detector Type	HgCdTe - Silicon
Operating Temperature (°Kelvin)	115 - Ambient
Scan Rate (rps)	14.0
Information Bandwidth (KHz)	53.0
Dynamic Range (Target Temp) (°Kelvin)	260 to 340
PERFORMANCE CHARACTERISTICS	
Noise Equivalent Temperature Difference NETD	0.3 Kelvin @ 280° Kelvin
Signal to Noise Ratio Near IR Channel	10 at 1.0% Albedo
PHYSICAL CHARACTERISTICS	
Weight (lbs)	53.8
Size (inches)	22 x 12 x 17
Power (watts) High Pwr - Low Pwr Vacuum Operation	24.0 - 21.0

SUMMARY OF OPTICAL PARAMETERS (HCMR)

IFOV (Instantaneous Field of View)	Square, 0.83 milliradian on an edge.

TELESCOPE

Type	Afocal Dall-Kirkam
Clear Aperture Diameter	8.00 inches
F-Number (Primary)	0.92
Exit Beam Diameter	1.00 inch
Mirror Substrate Mtl.	Cervit
Primary-Secondary Spacer Mtl.	Invar
Coating	Aluminized with Kanigen processing coating

System Optical Parameters, Near IR Channel

Relay	Air Space Triplet (See Dwg. 8120944 on p.7) 32 MM focal length
Effective System Focal Length	256.0 m.m.
F -Number*	1.26
Field Stop Edge Width	0.0084"
Dia. of Blur Spot, on Axis	0.0016"**
Dia. of Blur Spot, Field Corner	0.0022"**
MTF (on Axis) at 3 line pairs/m.m.	99.3%
MTF (Field Corner) at 3 line pairs/m.m.	99.2%
Focus Adjustment	±0.0326"
Clear Aperture	6.56" ***

*F-number defined as E.F.L. ÷ clear Aperture Diameter
**For spectral band from 0.60 to 1.10 μm and 100% energy
***Limited by size of Relay lens. Could not be changed without extensive SCMR Redesign.

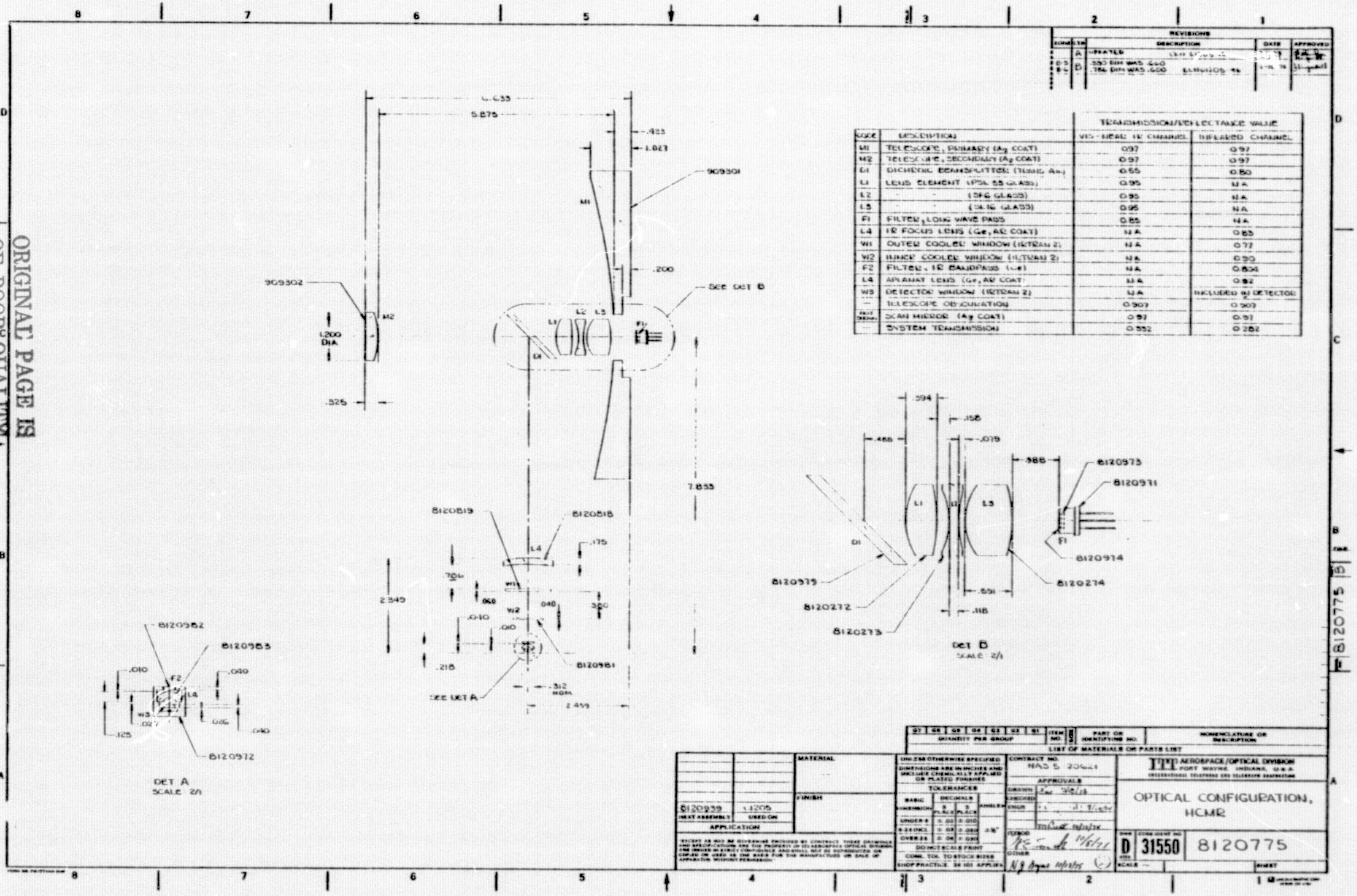
System Optical Parameters, Far IR Channel

Relay	Single Germanium Focus Lens with Germanium Aplanat Lens (Dwg. 8120945, p.11) 23.775 MM Focal length
Effective System Focal Length	190.2 m.m.
Field Stop Edge Width	0.0062"
F-Number	0.936
Dia. of Blur Spot, on Axis	0.0012"*
Dia. of Blur Spot, Field Corner	0.0042"*
MTF (on Axis) at 3.6 line pairs/m.m.	99.0%
MTF (Field Corner) at 3.6 line pairs/m.m.	95.5%
Focus Adjustment (air space between focus lens and aplanat)	±0.141"
Clear Aperature	8"

* For 100% energy

A schematic representation of the optical system is shown in Figure 1-1.

In the far infrared channel, the 0.83 m.r. field of view is determined by the sensitive area (0.0062 inch by 0.0062 inch) of a mercury-cadmium-telluride detector. In the near infrared channel, the field of view is set by a thin metal aperture disc with a square opening of 0.0084 inch by 0.0084 inch located at the focal plane of the near IR optics; a silicon detector with a 0.100 inch by 0.100 inch sensitive area is located just behind the aperture and responds to all the energy passing through it.



CODE	DESCRIPTION	TRANSMISSION/REFLECTANCE VALUE: VIS - NEAR IR CHANNEL	INFRARED CHANNEL
M1	TELESCOPE, PRIMARY (Ag COAT)	0.97	0.97
M2	TELESCOPE, SECONDARY (Ag COAT)	0.97	0.97
D1	DICHROIC BEAMSPLITTER (TRANS A=)	0.55	0.80
L1	LENS ELEMENT (PSK 53 GLASS)	0.95	N.A
L2	" " (SF6 GLASS)	0.95	N.A
L3	" " (SK16 GLASS)	0.95	N.A
F1	FILTER, LONG WAVE PASS	0.85	N.A
L4	IR FOCUS LENS (Ge, AR COAT)	N.A	0.83
W1	OUTER COOLER WINDOW (IRTRAN 2)	N.A	0.77
W2	INNER COOLER WINDOW (IRTRAN 2)	N.A	0.90
F2	FILTER, IR BANDPASS (Ge)	N.A	0.804
L4	APLANAT LENS (Ge, AR COAT)	N.A	0.92
W3	DETECTOR WINDOW (IRTRAN 2)	N.A	INCLUDED IN DETECTOR
—	TELESCOPE OBSCURATION	0.907	0.907
NOT SHOWN	SCAN MIRROR (Ag COAT)	0.97	0.97
—	SYSTEM TRANSMISSION	0.552	0.282

FIGURE 1-1

1.2.1 HCMR Spectral Response and Calibration of Visible/Near IR Band

In order to calibrate the visible/near infrared channel of HCMR the relative spectral response must be determined. The spectral response of this channel is set primarily by the Schott Type OG-550 filter on the short wave side and the falloff of the silicon detector on the long wave side; the in-band response is affected by the transmission of the optical elements and the detector response. Table 1-2 lists the measured data used to determine the spectral response of HCMR and the calculated system response using the Harshaw SN001 silicon detector.

The calibration of HCMR will be done using the 30-inch diameter integrating sphere (supplied by NASA/GSFC for calibration of AVHRR for Tiros N). The integrating sphere uses an array of twelve 45 watt G.E. quartzline lamps as the radiant source and since these lamps have a different spectral output than solar illumination this must be taken into account. First, we need to determine the "effective" solar reflected emittance (or exitance), N_e, for an earth scene at the nadir position at noon

$$N_e = \rho \int_{\lambda_1}^{\lambda_2} H_S \, T_r \, d\lambda$$

where ρ = scene reflectivity or albedo

λ = wavelength

H_S = spectral irradiance of the sun just outside the earth's atmosphere

T_r = normalized spectral response of HCMR

We assume constant scene reflectance in the spectral band 0.5 to 1.2 μm for calibration purposes, otherwise the spectral variance would have to be included inside the integral. The solar spectral irradiance (taken from an article by M. Thekaekara in Optical Spectra, p. 32, March 1972) is plotted in Figure 1-2 along with the HCMR response and the resulting product. The area under the product curve was measured with a planimeter (23.55 sq. inches) and converted to effective emittance (for 100% albedo) by multiplying by 2×10^{-3} watt per cm^2 for each square inch of area, giving 4.71×10^{-2} watts per cm^2 in the HCMR spectral band. For any albedo,

$$N_e = 4.71 \, \rho \times 10^{-2} \text{ watt/cm}^2.$$

A similar calculation was done using the known spectral emittance of the integrating sphere (see attached calibration data sheet). The sphere emittance and HCMR spectral response are

TABLE 1-2 MEASURED HCMR SPECTRAL DATA

WVLN	Focus Lens One Lens	Focus Lens Triplet	Scan Mirror	Gold Beam-splitter	OG 550 Spectral Filter	(1) Telescope Mirrors	Total Optics Trans.	(2) Silicon Detector Response	Optics Trans.X Detector Response	HCMR Relative Response
500m.m.	0.910	0.754	0.930	0.750	~ 0	0.902	~ 0	0.22	~ 0	~ 0
525	0.918	0.774	0.930	0.780	0.140	0.920	0.072	0.24	0.0173	0.062
550	0.925	0.791	0.930	0.800	0.845	0.931	0.463	0.26	0.120	0.432
575	0.933	0.812	0.930	0.819	0.920	0.943	0.535	0.28	0.150	0.540
600	0.938	0.825	0.930	0.829	0.929	0.958	0.566	0.29	0.164	0.590
650	0.945	0.844	0.922	0.838	0.930	0.976	0.592	0.32	0.189	0.680
700	0.952	0.863	0.910	0.830	0.930	0.984	0.596	0.42	0.250	0.899
750	0.957	0.876	0.895	0.802	0.930	0.984	0.575	0.44	0.253	0.910
800	0.959	0.882	0.868	0.760	0.930	0.986	0.534	0.46	0.246	0.885
850	0.960	0.885	0.852	0.708	0.930	0.978	0.486	0.57	0.277	0.996
900	0.960	0.885	0.855	0.643	0.930	0.980	0.443	0.62	0.278	1.000
950	0.960	0.885	0.860	0.580	0.930	0.980	0.402	0.57	0.229	0.824
1000	0.960	0.885	0.860	0.537	0.930	0.978	0.372	0.52	0.193	0.694
1050	0.960	0.885	0.858	0.481	0.930	0.974	0.331	0.37	0.122	0.439
1100	0.960	0.885	0.858	0.438	0.930	0.972	0.301	0.10	0.03	0.108
1150	0.959	0.882	0.860	0.401	0.930	0.976	0.276	0.03	0.008	0.029
1200	0.958	0.879	0.862	0.368	0.930	0.972	0.252	~ 0	~ 0	~ 0

(1) Product of primary & secondary mirror reflectance.

(2) Harshaw Chemical Co. Detector S.N. 001

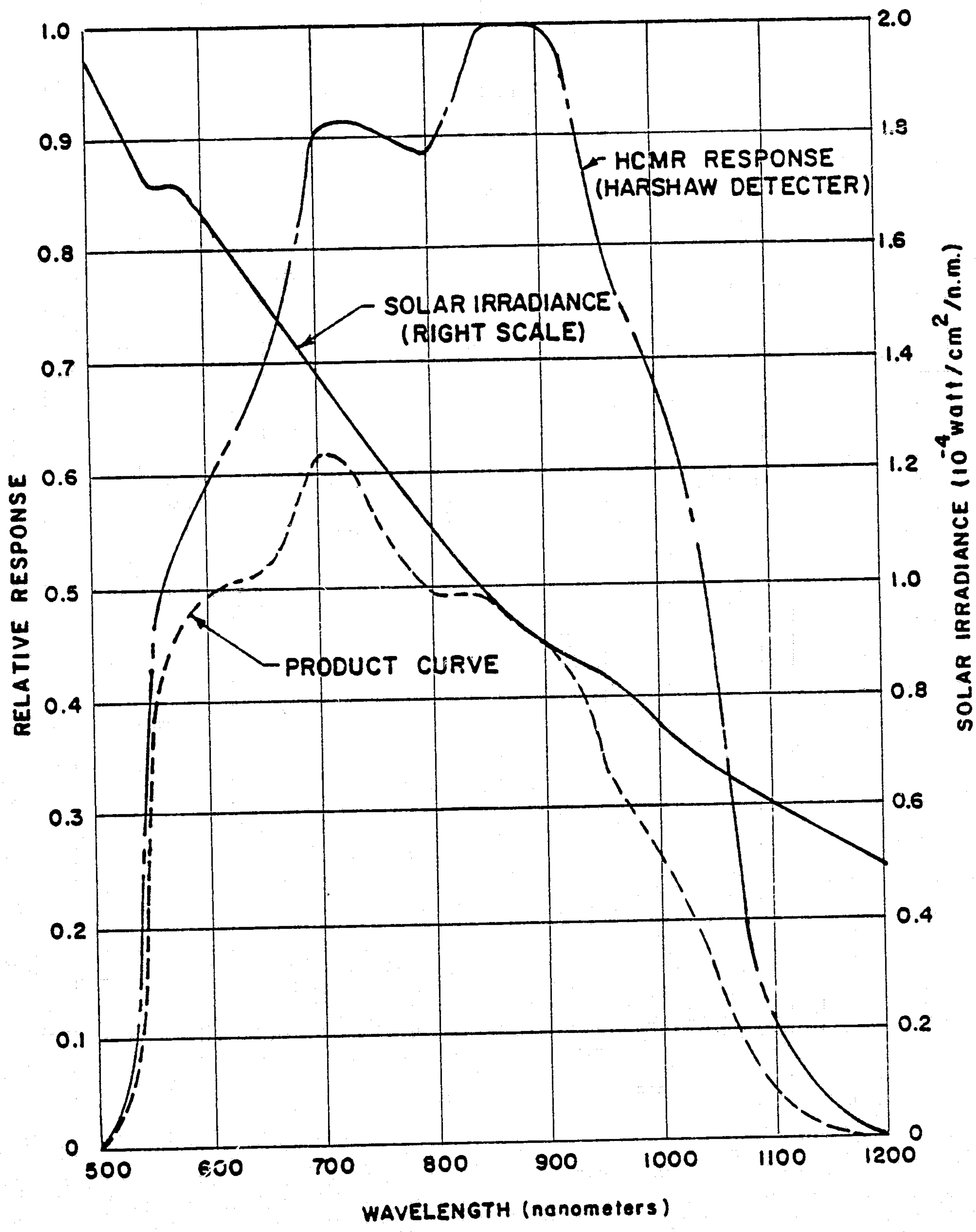


FIGURE 1-2 HCMR DETECTOR RESPONSE, SOLAR IRRADIANCE AND PRODUCT CURVES

(For ITT)

SPECTRAL RADIANT EMITTANCE* OF THIRTY-INCH SPHERICAL INTEGRATOR (AVHRR/TIROS-N)

(λ in millimicrons; $W\lambda$ in milliwatts $cm^{-2}\ \mu^{-1}$;
W'_λ in watta $m^{-2}\ \mu^{-1}\ sr^{-1}$)

λ	W_λ	W'_λ	λ	W_λ	W'_λ
320	1.002	3.253	900	205.9	655.5
350	3.542	11.27	1050	179.0	569.8
400	12.55	39.94	1150	157.3	500.6
450	30.55	97.23	1200	145.9	464.4
500	56.00	178.2	1300	127.3	405.2
555	85.87	273.3	1540	73.9	235.4
600	109.9	349.7	1600	67.8	215.7
654.6	135.4	431.0			
700	153.3	487.8			
800	194.4	618.8			

RATIO OF INTENSITY OF N LAMPS TO 12 LAMPS IN SPHERICAL INTEGRATOR

No. of Lamps	$W_{\lambda n}/W_{\lambda_{12}}$
12	1.0000
11	.9154
10	.8334
9	.7504
8	.6647
7	.5801
6	.4949
5	.4130
4	.3342
3	.2475
2	.1628
1	.0798

*W_λ is emittance (or "exitance"); W'_λ is radiance (or "radiant sterance").

plotted in Figure 1-3 along with the resulting product curve. The area under the curve (36.26 sq. inches) times 2×10^{-3} watts per cm^2 for each square inch yields an integral of 7.25×10^{-2} watts per cm^2 for all 12 lamps turned on, i.e., this is the total sphere 'effective' emittance for the HCMR spectral response. For 7 lamps on, the sphere effective emittance is $0.5801 \times 7.25 \times 10^{-2}$ watt cm^{-2} or 4.21×10^{-2} watt per cm^2 which corresponds to a scene albedo of 89.3% (7.79 lamps would give 100% albedo). Similarly, using $4.71 \ \rho = r \times 7.25$ where r is the ratio for ON lamps to 12 lamps from the sphere calibration data, we obtain

No. of lamps	% Albedo
1	12.3
2	25.1
3	38.1
4	51.4
5	63.6
6	76.2
7	89.3
8	102.3

1.2.2 HCMR IR Spectral Response

The spectral response for the HCMR IR channel is shown in Figure 1-4. The data from which this curve is contructed is detailed in Table 1-3 and the accompanying curves of the IR channel spectral filter and IR channel detector.

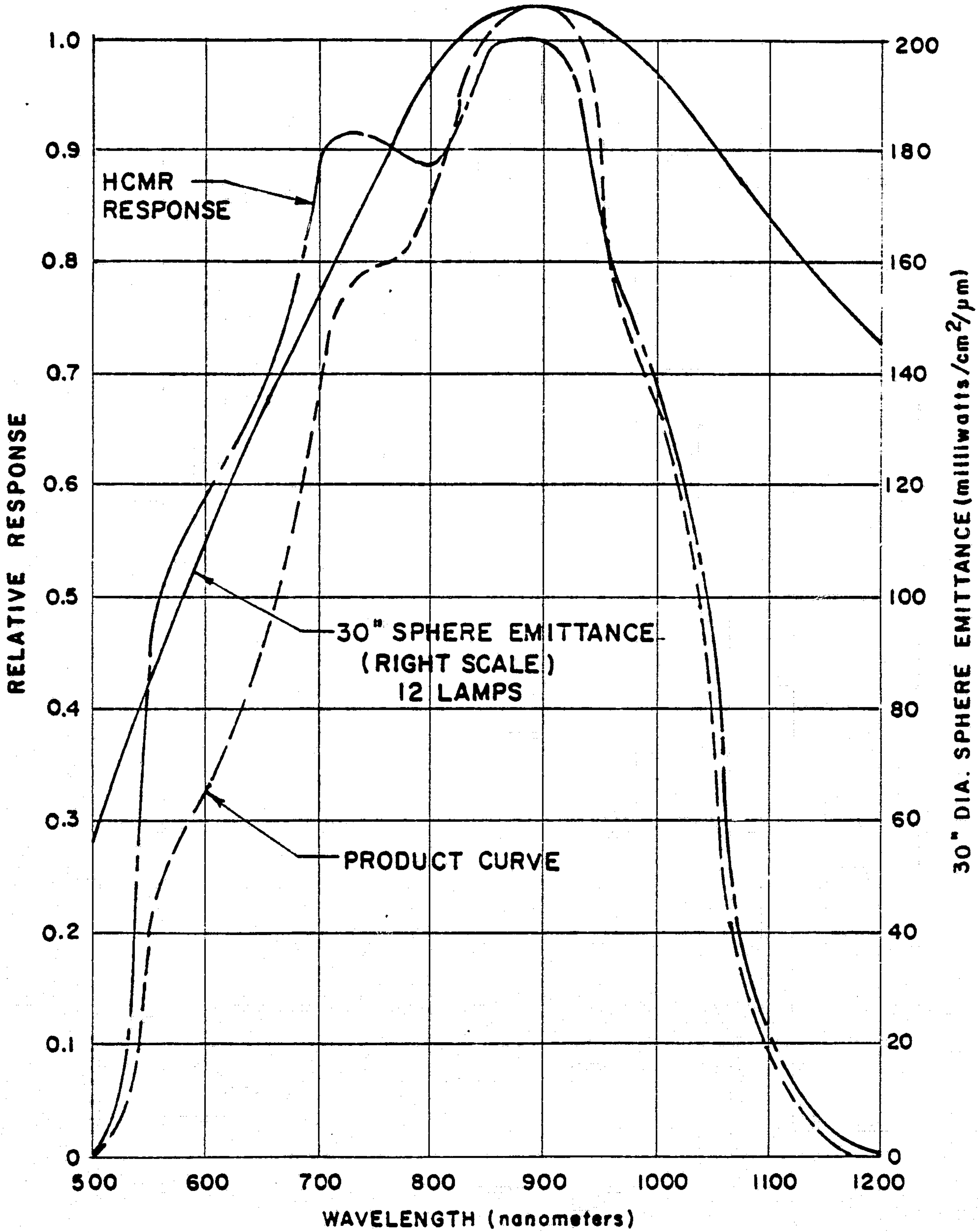


FIGURE 1-3 HCMR SPHERE EMITTANCE, SPECTRAL RESPONSE AND PRODUCT CURVES

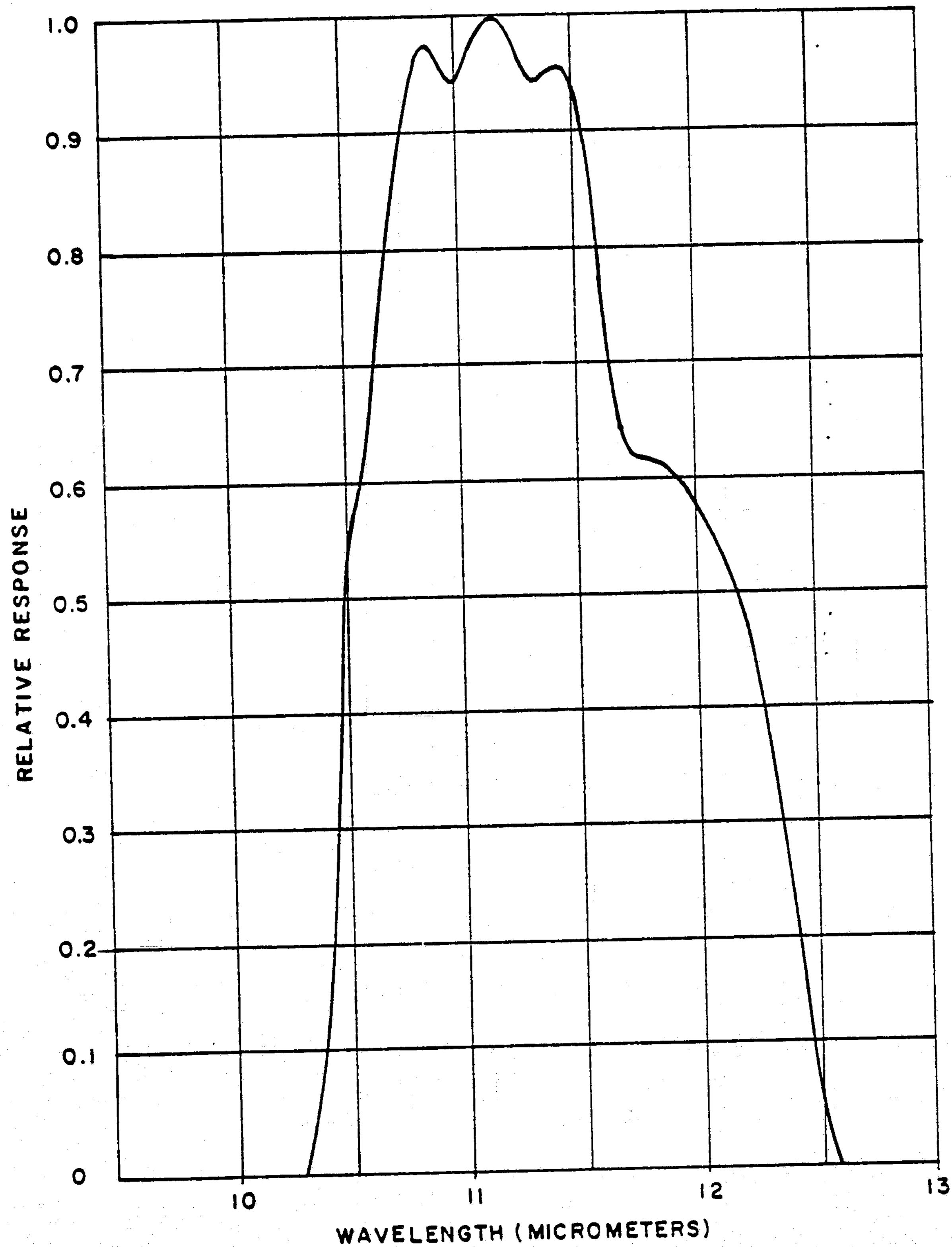


FIGURE 1-4 HCMR SPECTRAL RESPONSE, IR CHANNEL

TABLE 1-3 HCMR SPECTRAL RESPONSE PARAMETERS, IR

WVLN.	$\nu (CM^{-1})$	BAND-PASS FILTER	FOCUS LENS	APLANAT LENS	COOLER WINDOW, HSNG.	COOLER WINDOW, CONE	HgCdTe DETECTOR 115KELVIN	PRODUCT	RELATIVE RESPONSE
10.29μm	972-1	-0-	---	---	---	---	---	---	-0-
10.4	961	0.11	0.910	0.920	0.902	0.890	0.945	0.070	0.118
10.5	952	0.46	0.915	0.925	0.899	0.889	0.955	0.297	0.500
10.6	943	0.58	0.920	0.930	0.892	0.881	0.968	0.377	0.635
10.7	935	0.74	0.922	0.935	0.885	0.879	0.978	0.485	0.816
10.8	926	0.83	0.923	0.939	0.879	0.875	0.989	0.547	0.921
10.88	919	0.881	0.925	0.941	0.875	0.871	0.992	0.580	0.976
11.01	908	0.842	0.930	0.945	0.870	0.870	1.000	0.560	0.943
11.17	895	0.898	0.932	0.950	0.867	0.870	0.991	0.594	1.000
11.34	882	0.866	0.939	0.950	0.869	0.873	0.958	0.561	0.944
11.47	872	0.895	0.940	0.950	0.872	0.881	0.920	0.565	0.951
11.60	862	0.81	0.940	0.950	0.879	0.879	0.840	0.469	0.790
11.75	851	0.70	0.940	0.948	0.882	0.890	0.748	0.366	0.617
11.90	840	0.81	0.930	0.942	0.880	0.887	0.650	0.360	0.606
12.05	830	0.89	0.931	0.940	0.869	0.880	0.560	0.334	0.561
12.19	820	0.886	0.932	0.939	0.859	0.875	0.490	0.286	0.481
12.34	810	0.80	0.931	0.931	0.848	0.871	0.405	0.207	0.349
12.50	800	0.15	0.921	0.922	0.831	0.870	0.310	0.028	0.048
12.58	795	-0-	---	---	---	---	---	---	-0-

NOTE: (1) DICHROIC BEAMSPLITTER, SCAN MIRROR & TELESCOPE MIRRORS ALL HAVE UNIFORM TRANSMISSION/REFLECTION OVER THIS SPECTRAL REGION.

(2) WAVELENGTHS WERE SELECTED IN-BAND AT PEAKS AND VALLEYS OF BANDPASS FILTER TRANSMISSION CURVE, RELATIVE RESPONSE SHAPE (OF HCMR) FOLLOWS SHAPE OF B.P. FILTER BETWEEN WAVELENGTHS IN TABLE.

S.N.6 used in FIT. HCMR ..

OCLI OPTICAL COATING LABORATORY, INC.

2789 Giffen Avenue
Santa Rosa, California
Telephone (707) 545-6440

SPECTRAL PERFORMANCE

DATA IDENTIFICATION

OCLI W/O 14-9407-430

12415-1114-222A

Run No. 12418-1114-223

Serial No. 8120982-1

ITEM # 3

SAMPLE IDENTIFICATION

Filter Type BAND PASS

Material GERMANIUM

Configuration W.T. 4635

.040"

INST. OPERATING PARAMETERS

☐ CARY 90 ☒ IR-12 J-24
☐ CARY 14 ☐ IR-4
☐ PE 180 ☐

Resolution 2 X STD SLIT

Scan Speed 20 cm⁻¹/MIN

Response INF

Aperture 0.8"

Expansion 0-100

☒ Percent Transmission
☐ Percent Reflection
☐

TEST CONDITIONS

Temp. -158°C. Angle 0°

CRYOSTAT W/CsI WINDOWS.

Analyst REC Date 1-8-76

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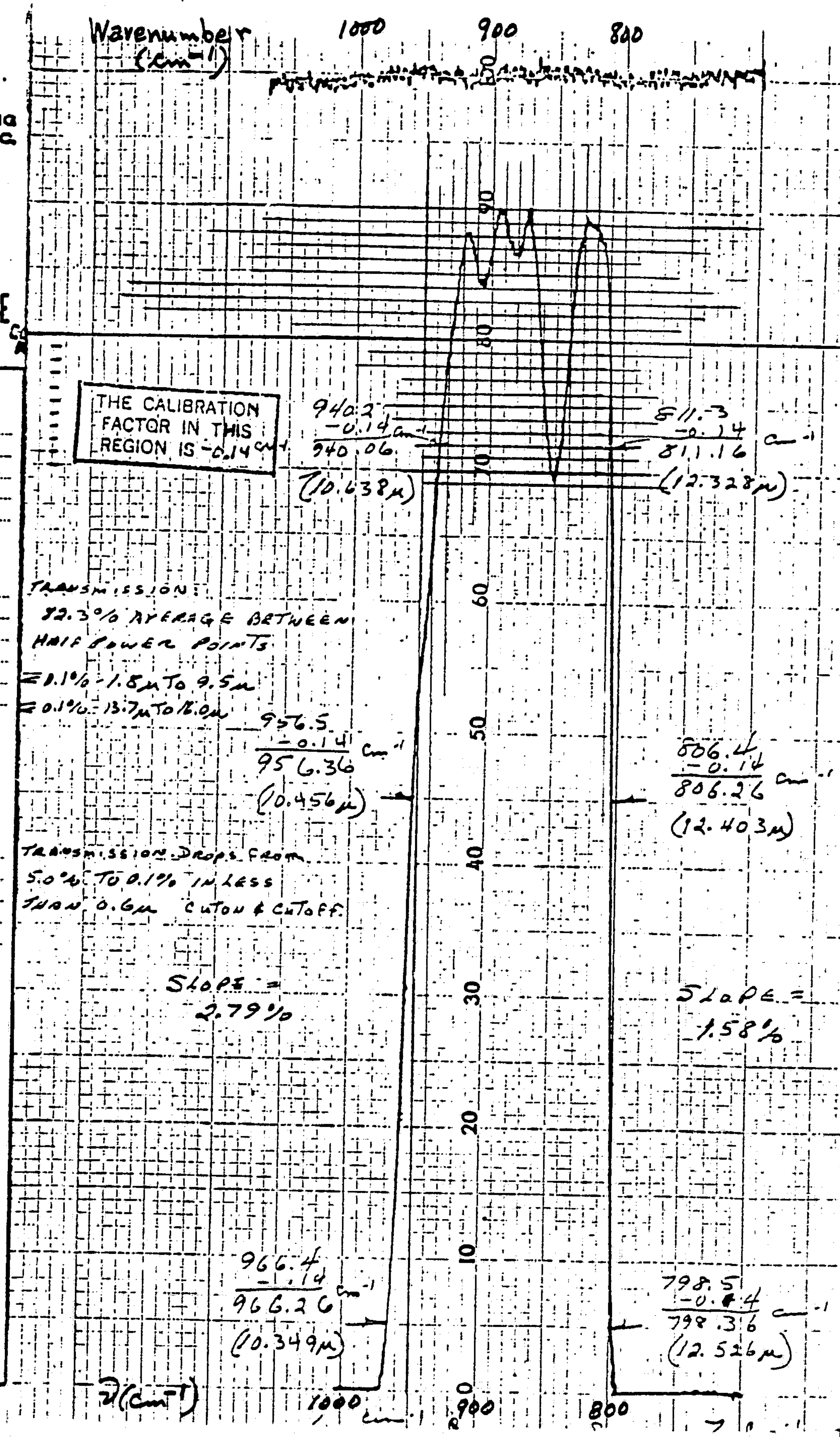
☒ Wavenumber
~~Wavelength~~ in cm⁻¹



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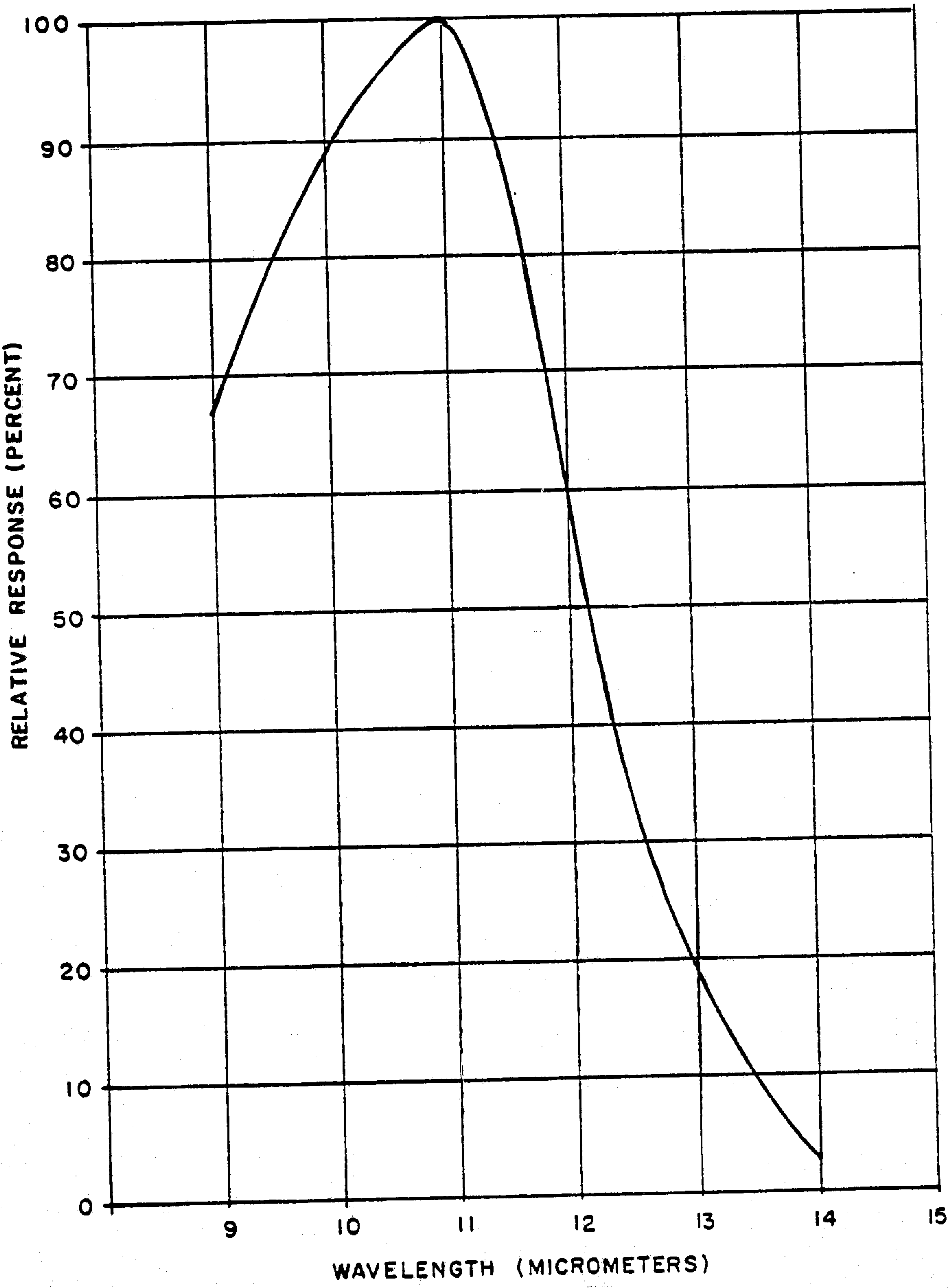


SPECTRAL RESPONSE OF HCMR HgCdTe (S.N.T-1) @ 115k

1.3 Electronic Processing

The detectors produce a small a.c. electrical signal which is proportional to the difference in radiant energy between the scene and cold space. The electrical signals form the detectors are amplified in each video amplifier to a level required for processing. Each video amplifier contains a low noise pre-amplifier, video filter and postamplifier. A space clamping technique is also used which establishes the d.c. zero level once every rotation of the scanner by clamping the output to zero when viewing cold space and holding this level for the duration of the scan. The overall video amplifier gain will be such that the highest energy scene will provide a 6 volt output signal. Calibration signals consisting of a 6 step staircase waveform,(a small step near zero volts may or may not be present depending on gain and offset adjustments), will be inserted at the amplifier input as well as at the amplifier output on every scan line to provide constant calibration and complete assessment of the amplifier performance. At the amplifier output, synchronizing pulses are also gated in along with the output calibration to make up the composite video. Output buffer amplifiers with unit gain and low output impedance are used for the output interface to the data system.

The timing and control logic will generate timing signals for generating the synchronizing pulses, the input and output calibration waveforms and the space clamp signals. The 14 KHz spacecraft clock signal is used as the basic counting frequency by the logic and a magnetic pickup mounted near the periphery of the rotating mirror initiates the counters once every rotation.

The calibration circuitry consist of an accurate, stable digital to analog converter which will generate a staircase of six-one volt steps for insertion at the amplifier input and output.

The power converters will convert the +28 volt spacecraft buss power into the highly regulated voltages required by the various electronic circuits. A 140 KHz internal oscillator synchronized to the 70 KHz spacecraft clock will be used for synchronizing the DC-DC converter.

The motor power supply will derive its power from the +28 VDC buss. This supply will amplify the 560Hz, 2 phase a.c. clock signals to power the synchronous motor for driving the mirror and compensation motor.

1.4 Radiant Cooler

The radiant cooler is designed to cool the patch to the $110^{\circ}K$ range. The patch is controlled in temperature to $115^{\circ}K$ by a temperature control circuit which supplies control heat to the patch and also monitors patch temperature with a platinum resistor sensor. The radiant cooler cooldown characteristics are shown in Figure 1-5.

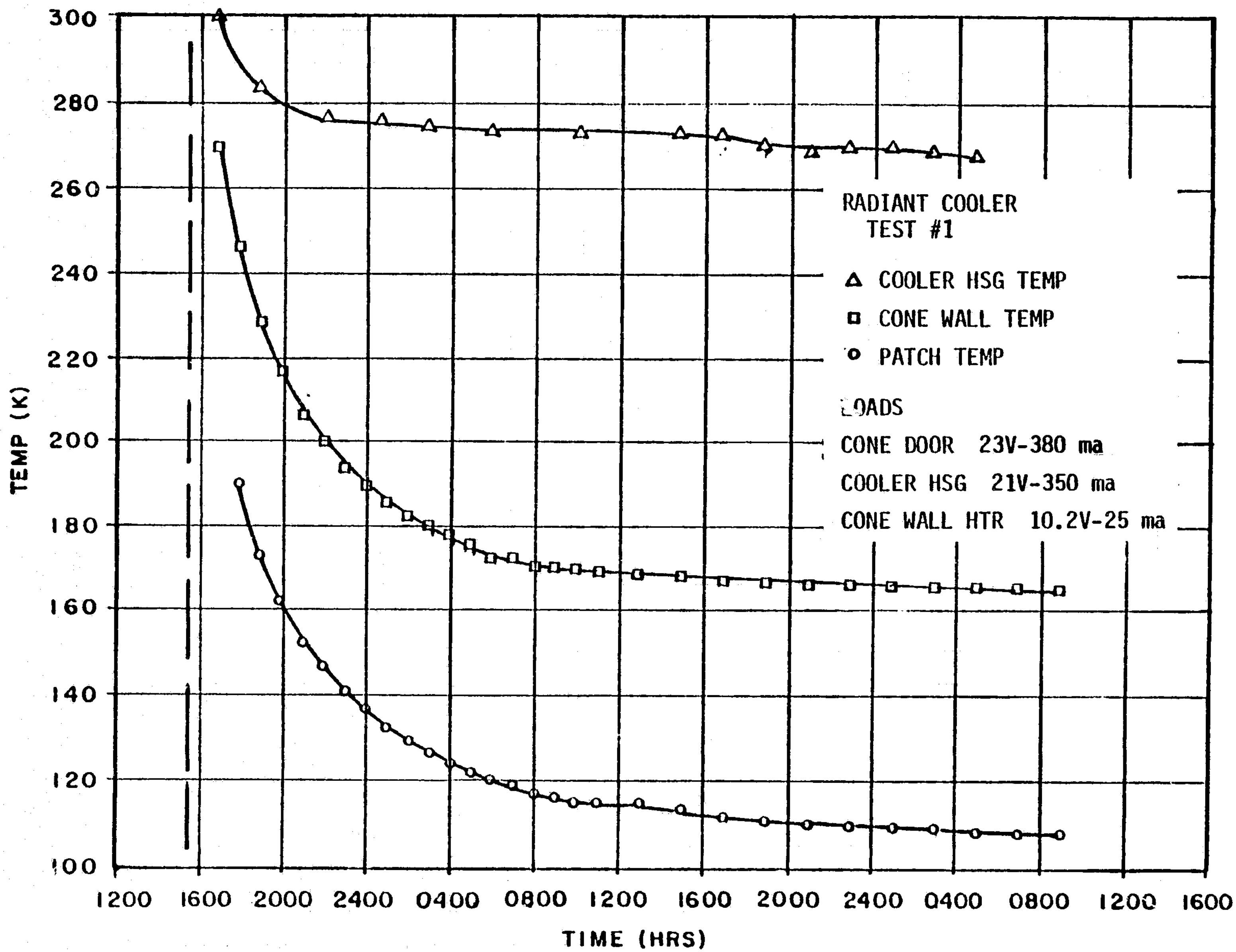


FIGURE 1-5 RADIANT COOLER COOLDOWN CHARACTERISTIC

1.5 Scan Sequence

The HCMR scan sequence is illustrated diagramatically in Figure 1-6. The scan sequence is initiated with the occurrence of Sync Pulse #1. This sync pulse is generated by a ferrous slug rotating past a magnetic pickup. * These ferrous slugs are attached to the scan mirror balancing weight in the rear motor housing. The slugs and magnetic pickups are located such that the sync pulse occurs at the instant the instrument field of view clears the housing and "looks" at space. The sync pulse is used to reset the scan cycle logic utilized to generate the temperature telemetry, Sync Pulse #2 and the precursor burst. The leading edge of Sync Pulse #1 defines the 0° angular position and zero time for events occurring in the scan. The scan sequence and format are shown in Figures 1-6 through 1-8 and in Figures 3-4 and 3-5.

1.6 Operational Current

Table 1-4 lists the current and power required by the HCMR for various command modes and for in-air and vacuum operation.

* Redundant magnetic pickups switchable on command are available to produce the sync. pulse.

Table 1-4 HCMR POWER MEASURED DATA

IN-AIR OPERATION

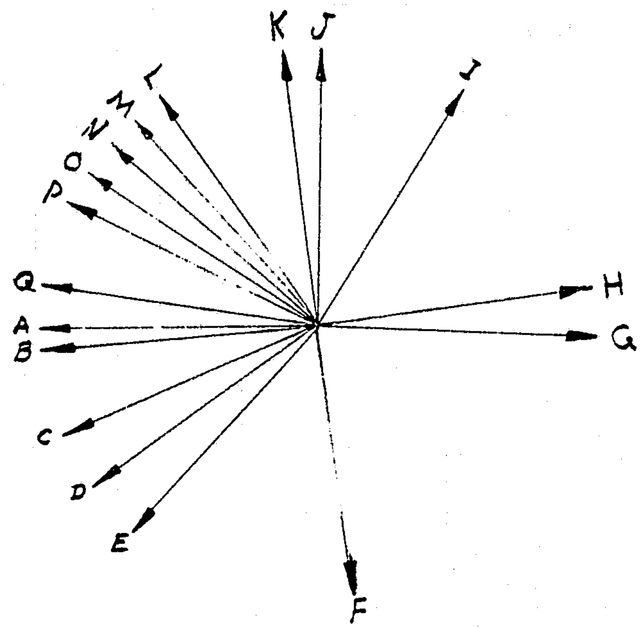
CMD MOTOR	STATUS ELEC	INPUT VOLTAGE VOLTS	MOTOR CURRENT MA	MOTOR POWER WATTS	ELEC. CURRENT MA	ELEC. POWER WATTS	T/M CURRENT MA	T/M POWER WATTS	TOTAL CURRENT MA	TOTAL POWER WATTS
OFF	OFF	28	0	0	0	0	0	0	0	0
HIGH	OFF	28	683	19.1	0	0	160	4.5	843	23.6
LOW	OFF	28	303	8.5	0	0	160	4.5	463	12.96
OFF	ON	28	0	0	243	6.8	160	4.5	403	11.3
HIGH	ON	28	683	19.1	243	6.8	160	4.5	1086	30.4
LOW	ON	28	303	8.5	243	6.8	160	4.5	706	19.8
SCAN MOTOR ONLY		28	592							
SCAN MOTOR LOW		18	212							
COMP. MOTOR ONLY		28	91							

NOTES:

1. T/M CURRENT IS NOT DIRECTLY MEASURED
2. MOTOR CURRENT INCLUDES BOTH SCAN & COMP. MOTORS
3. T/M CURRENT IS "ON" WHEN EITHER CMD IS "ON"

IN-VACUUM OPERATION

CMD MOTOR	STATUS ELEC	INPUT VOLTAGE VOLTS	MOTOR CURRENT MA	MOTOR POWER WATTS	ELEC. CURRENT MA	ELEC. POWER WATTS	T/M CURRENT MA	T/M POWER WATTS	TOTAL CURRENT MA	TOTAL POWER WATTS
OFF	OFF	28	0		0		0		0	0
HIGH	OFF	28	600	16.8	---		160	4.5	760	21.3
LOW	OFF	28	287	8.0	---		160	4.5	447	12.5
OFF	ON	28	---	---	243	6.8	160	4.5	403	11.3
HIGH	ON	28	600	16.8	243	6.8	160	4.5	1003	28.1
LOW	ON	28	287	8.0	243	6.8	160	4.5	690	19.3
SCAN MOTOR ONLY		28	509							
		18	196							
COMP MOTOR ONLY		28	91							



Reference Letter	Angle (degrees)	Time (mSec)	Event
A	0	0	Begin Sync Pulse #1
B	3.6	.714	End Sync Pulse #1
C	21.6	4.28	Begin Input Calibration
D	34.2	6.79	End Input Calibration
E	42.9	8.51	Begin Earth Scan
F	109	21.63	Nadir
G	175.1	34.74	End Earth Scan
H	189.	37.5	Begin Output Calibration
I	239.4	47.5	End Output Calibration
J	270.4	53.65	Begin Internal Target View
K	278.3	55.22	Complete Internal Target View
L	304.2	60.36	Begin Internal Target Temp Telemetry
M	311.4	61.78	End Internal Target Temp. Telemetry
N	318.6	63.21	Begin Sync Pulse #2
O	325.8	64.64	End Sync Pulse #2
P	333.0	66.07	Begin Precursor Burst
Q	351.0	69.64	End Precursor Burst

FIGURE 1-6

HCMR SCAN SEQUENCE

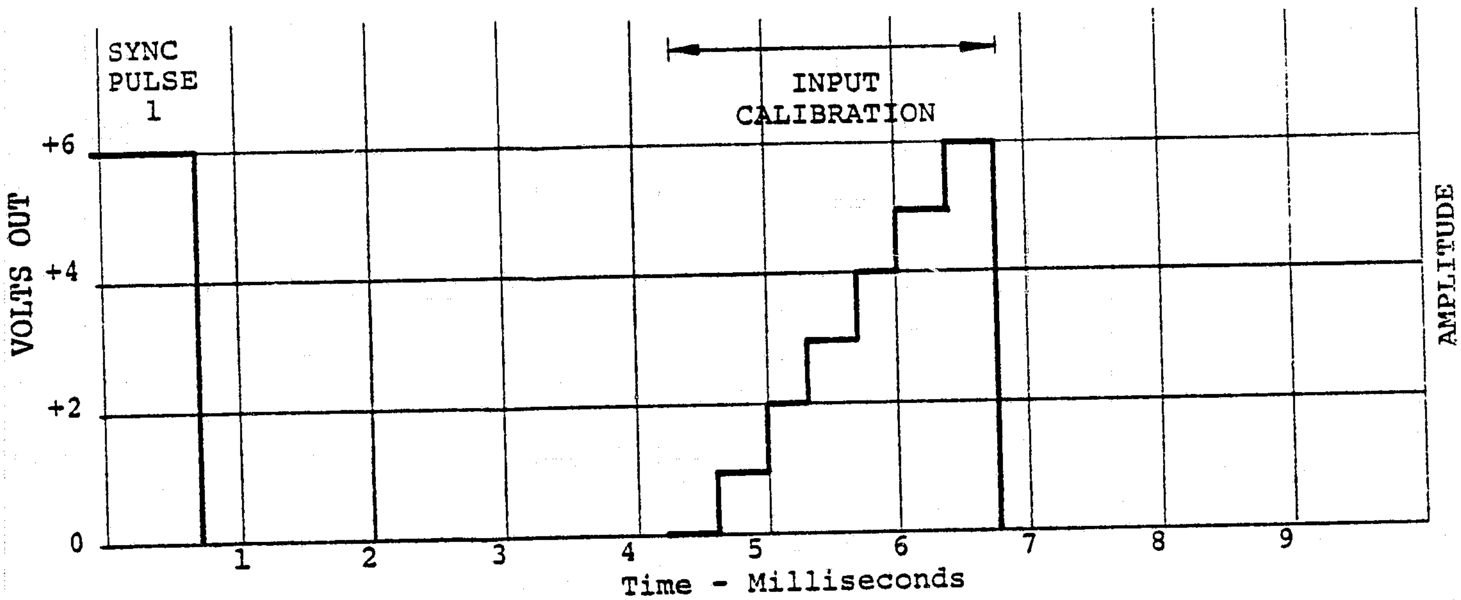


FIGURE 1-7 INPUT CALIBRATION SEQUENCE

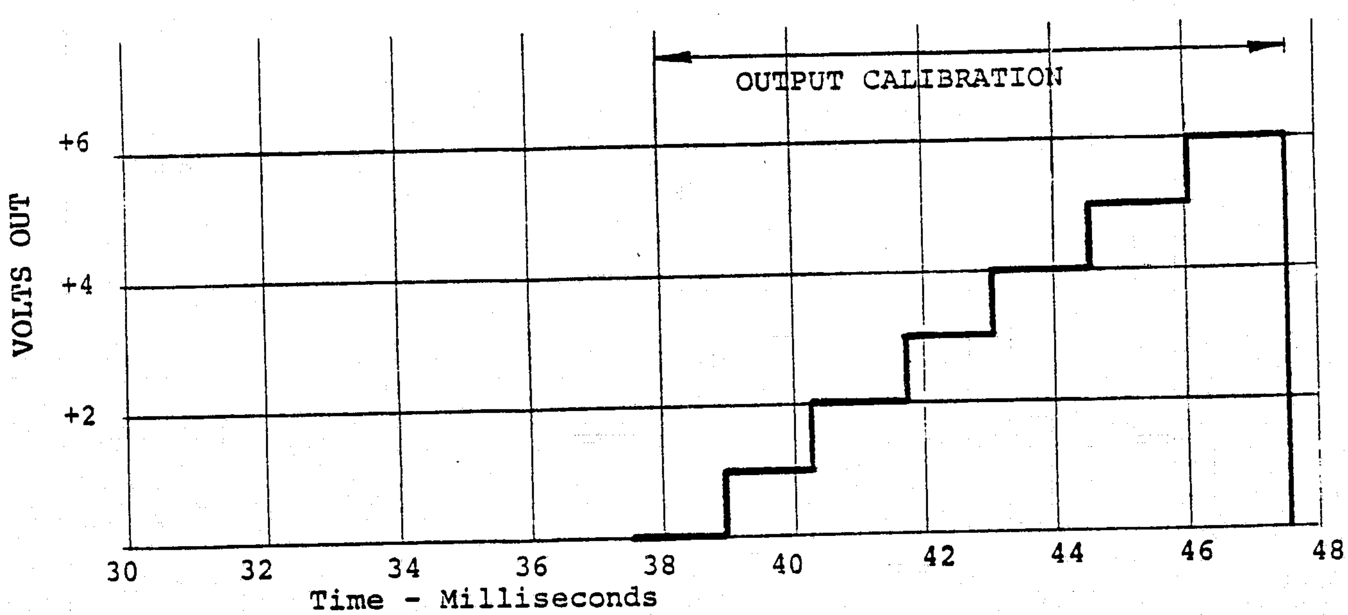


FIGURE 1-8 OUTPUT CALIBRATION SEQUENCE

2.0 MECHANICAL INTERFACE

An outline drawing (ITT Dwg. 8121360) showing mechanical interface of the HCMR instrument is included in this report as Figure 2-1. The instrument is shown with outside dimensions of 25.11 inches long by 11.5 inches wide by 17.68 inches high with the cooler door closed. The instrument weighs 53.8 lbs. A momentum compensator is included in the instrument. It reduces the uncompensated momentum to 0.011 ft. lb. sec.

The view angle for the scanner is shown in this figure. When the instrument is mounted on the spacecraft, 145° of scanner angle as shown must be unobstructed. In addition, the following areas listed below must be left open.

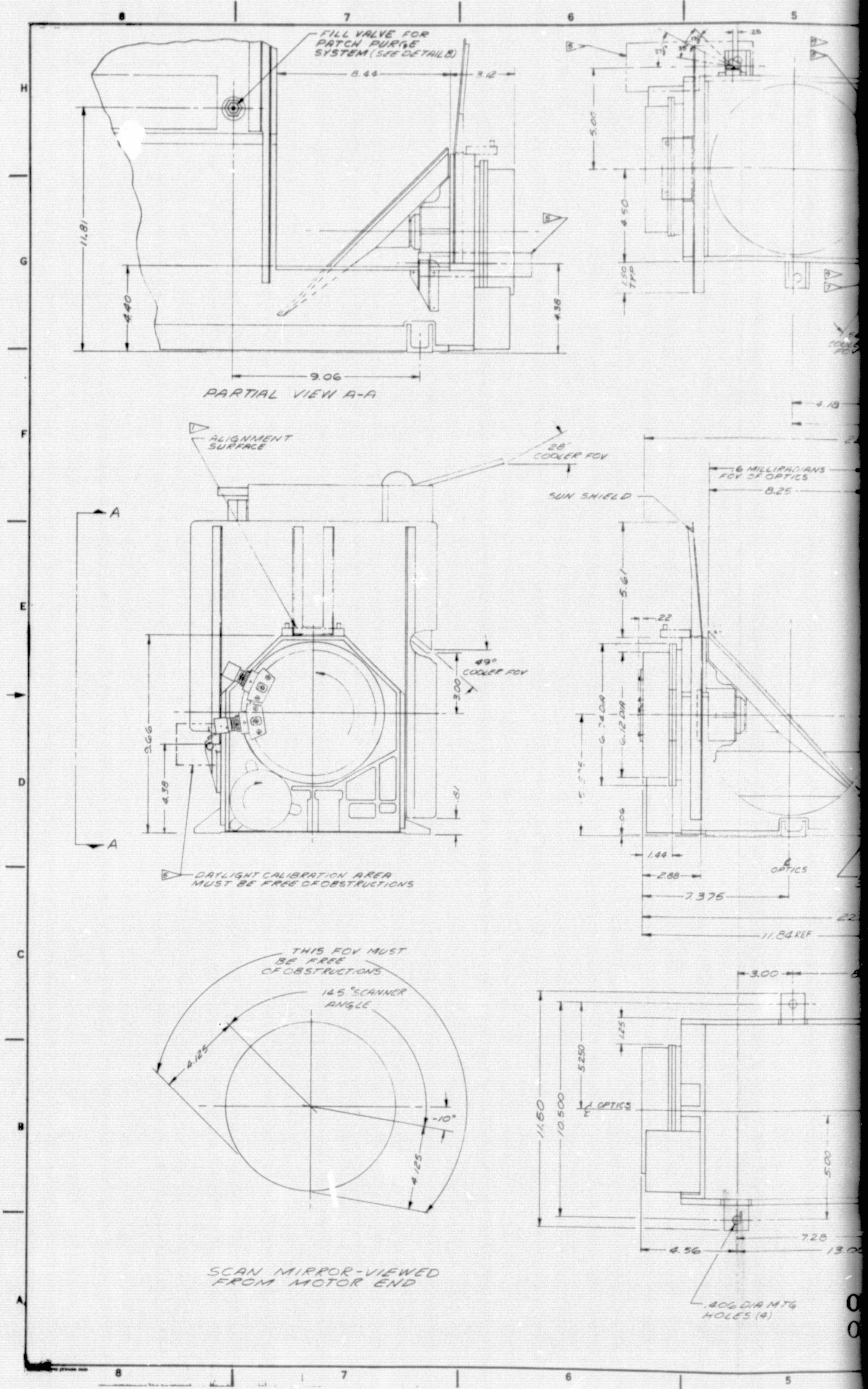
1. Area surrounding daylight calibration assembly.
2. Area in front of radiant cooler including viewing angle and path of cooler door deployment.
3. Radiating Panel for cooling electronics.
4. Radiating Panel for cooling radiant cooler housing.
5. Access area for filling patch purge system.

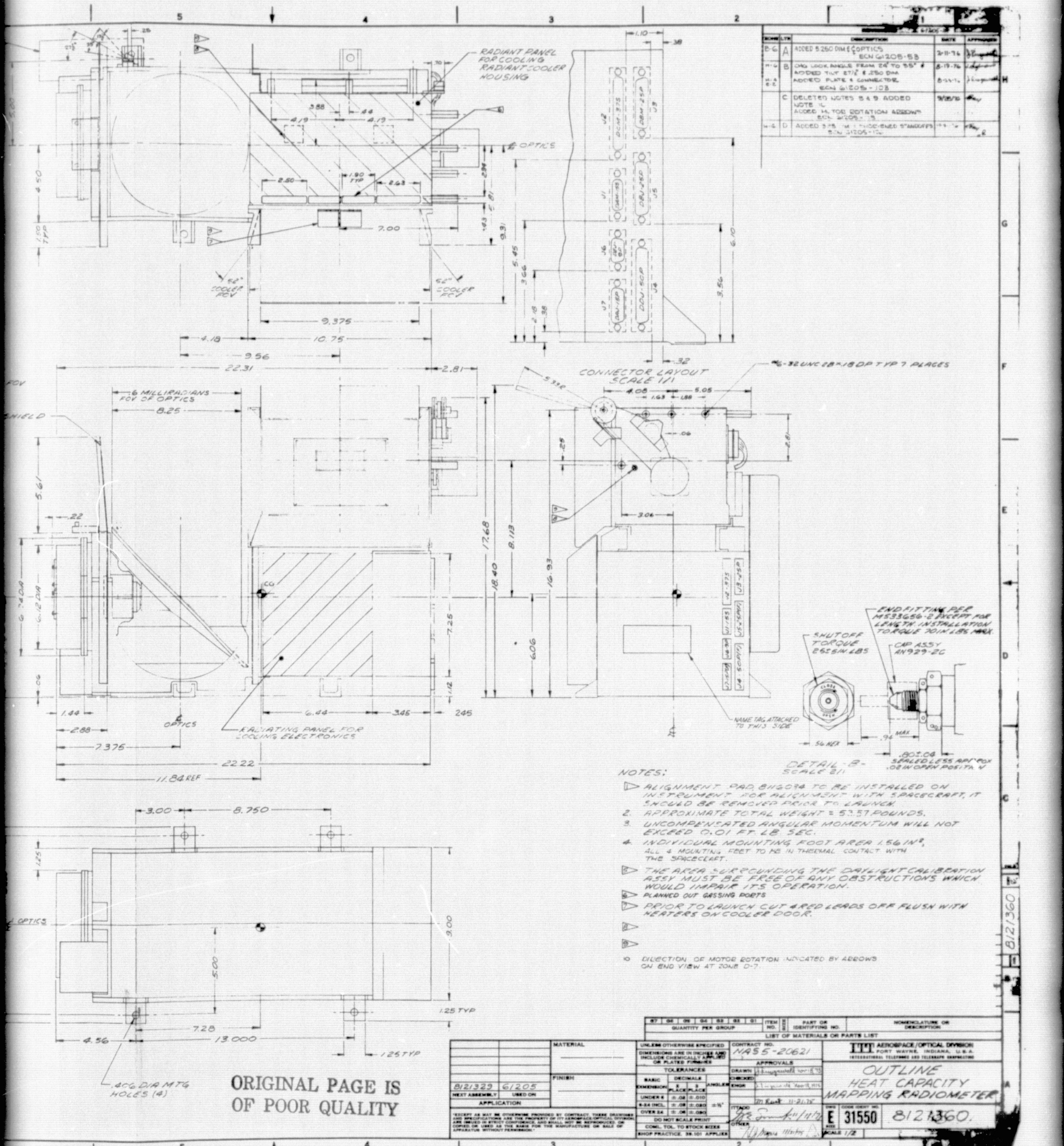
Means is provided for attachment of a thermal blanket to the exterior of the instrument after installation of the spacecraft. This blanket was supplied by the spacecraft contractor and not by ITT.

Built into the instrument is a purge system for flushing the volume around the radiant cover patch with ultra-dry nitrogen while in orbit. This system may be exercised during pre-launch test but should be recharged prior to launch. A transducer is installed in the system for measuring gas supply pressure.

The instrument is designed with four mounting feet. Mounting bolts are 3/8-16. The four mounting feet are to be in thermal contact with the spacecraft. A compensation heater of 10 watts capacity is attached to the scan motor housing.

The motor and momentum compensator operated continously-- even during launch.


FILL VALVE FOR PATCH PURGE SYSTEM (SEE DETAIL B)
PARTIAL VIEW A-A
ALIGNMENT SURFACE
28° COOLER FOV
SUN SHIELD
6 MILLIRADIANS FOV OF OPTICS
49° COOLER FOV
DAYLIGHT CALIBRATION AREA MUST BE FREE OF OBSTRUCTIONS
THIS FOV MUST BE FREE OF OBSTRUCTIONS
14.5° SCANNER ANGLE
SCAN MIRROR-VIEWED FROM MOTOR END
.406 DIA MTG HOLES (4)



FOLDOUT FRAME 2

Figure 2-1

Figures 2-2 and 2-3 show the locations of the pertinent features of the HCMR.

Figure 2-2 shows on the left, the drive assembly which consists of drive motor, dynamic masses (for balance and momentum compensation) and the scanning mirror. This subassembly is dowel pinned to the base for accuracy.

To the right of the scanning mirror, the collector telescope and optics subassembly will be mounted. This subassembly, too, will be dowel pinned to the base for accuracy. Therefore, the scanning system and optics will be held to precise alignment - to ± 0.0002 in. both transverse and parallel to the optical axis.

The cooler is mounted directly above the optical subassembly. The cooler is dowel pinned to the optics for alignment of the IR detector to the optical axes.

The electronics module will be located at the far right end of the instrument. The electronics are isolated thermally from the main structure. The panel directly below the radiant cooler to the left of the electronics module is tied thermally to the electronics housing and serves as a radiator for heat generated by the electronics.

The near IR detector and assembly is mounted in front of the left side of the electronics module and in the center of the instrument optical axis.

Four mounting tabs protruding from the baseplate will serve to mount the instrument to the spacecraft. Connections are located on the back of the instrument. The reference blackbody is located on the top of the baseplate and directly below the scanning mirror.

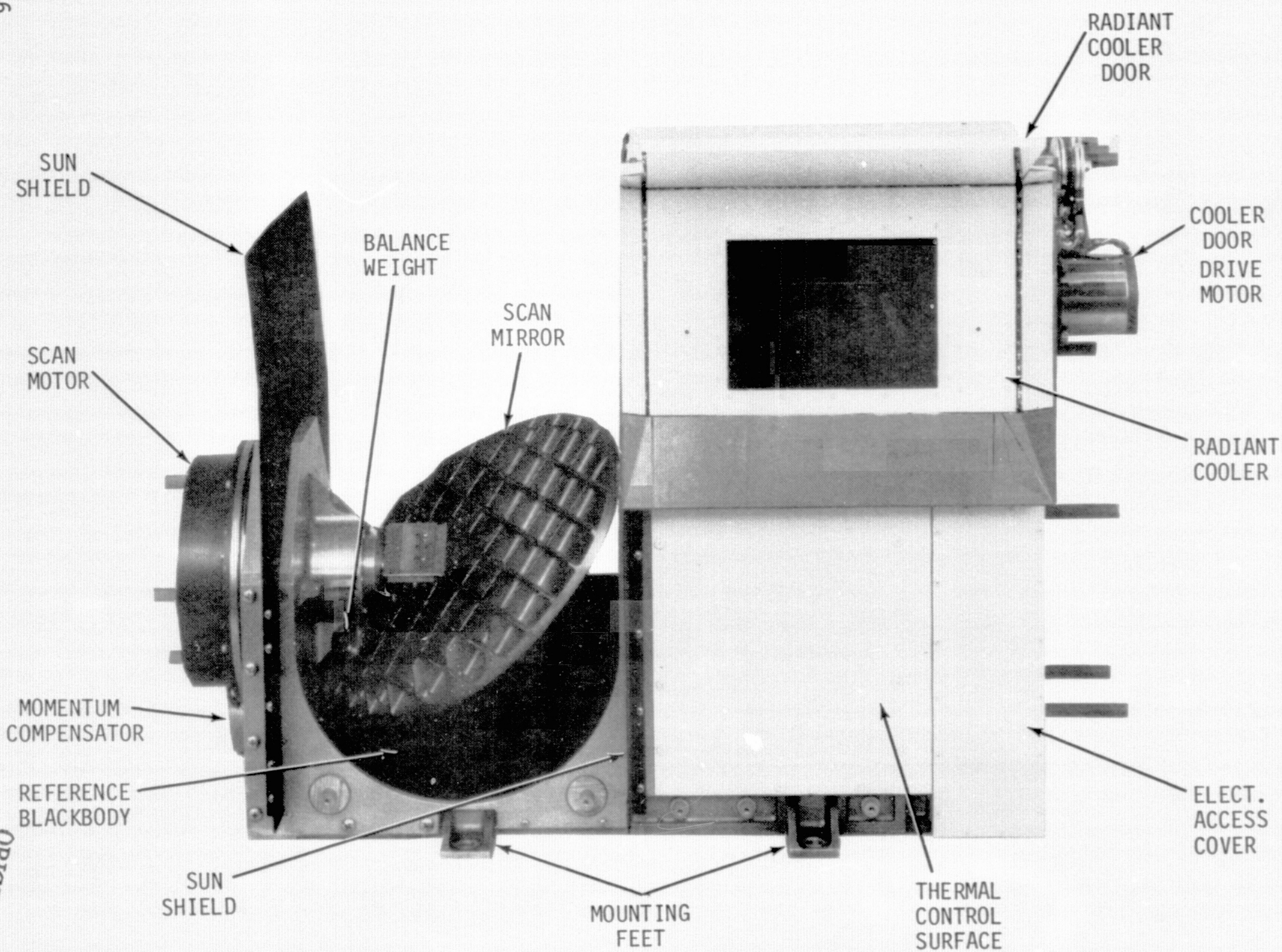


FIGURE 2-2 HCMR PERTINENT FEATURES

Figure 2-3 shows the Purge fill valve and IR preamplifier in the upper left hand corner. The panel labeled wiring cover provides access to the instrument connector wiring.

On the right of Figure 2-3 the two redundant magnetic pickups can be seen and just to the left of the lower pickup is the visible calibration entry port. During part of the orbit sunlight is directed through this port onto the scan mirror and ultimately to the near IR detector. This is used as a near calibration reference.

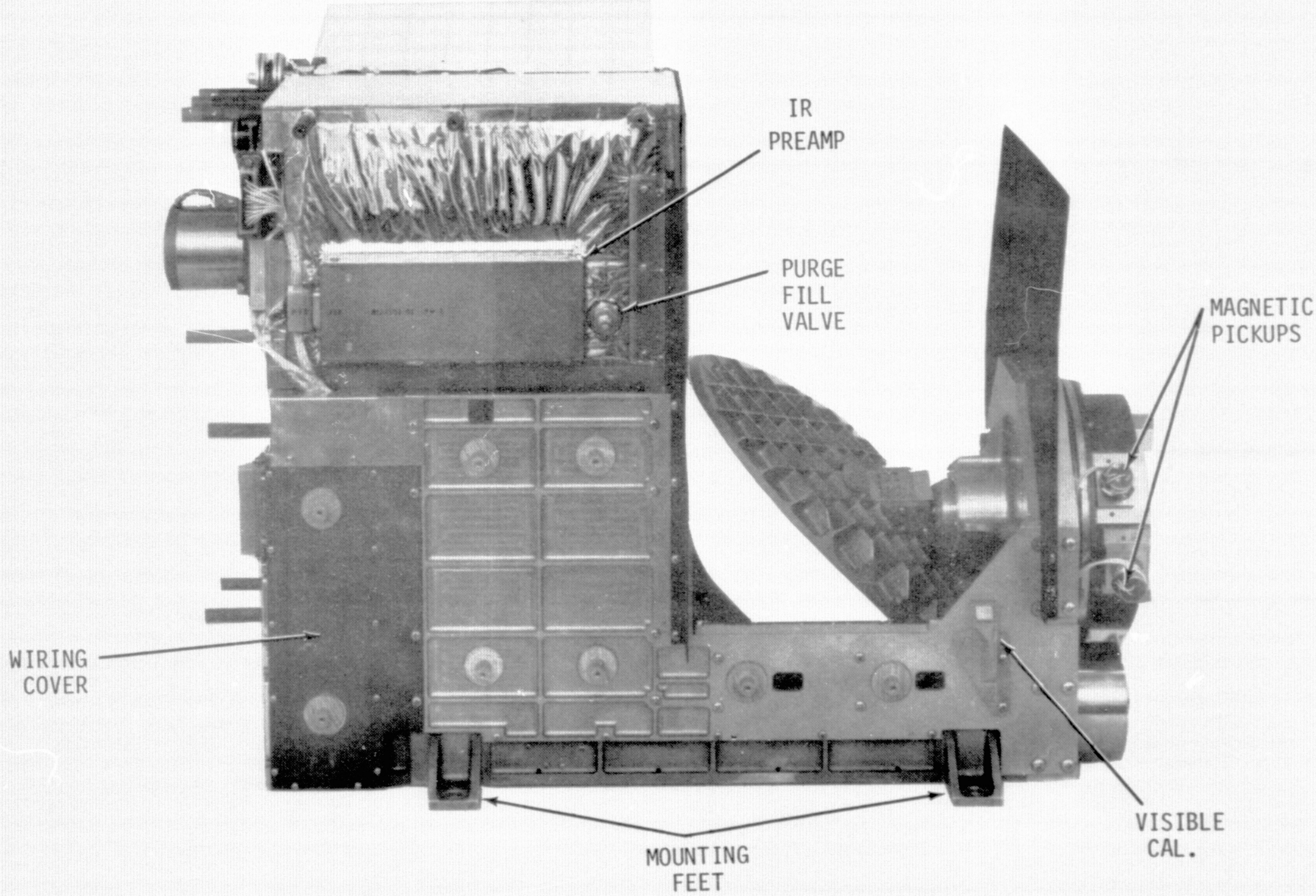


FIGURE 2-3 HCMR PERTINENT FEATURES

3.0 HCMR ELECTRICAL SYSTEM

A simplified Block Diagram of the HCMR Electronics is shown in Figure 3-1. The HCMR Electronics has the function to transmit to the spacecraft two channels of video data synchronized with the spacecraft clock and the rotation of the HCMR scan mirror. The input signals to the HCMR are the spacecraft +28.0 VDC bus, clock signals of 70 KHz, 14 KHz and 560 Hz 2-phase, and spacecraft commands to the HCMR to implement the available modes of operation. The HCMR electronics provides the power conversion, timing and control, signal generation, digital and analog telemetry for verification of operation, and signal amplification for required operation.

The basic blocks of the HCMR are:

1. IR Data Amplifiers
2. Visible Data Amplifiers
3. Power Converter
4. Voltage Regulators
5. Timing and Control Circuits
6. Calibration signal generation circuits
7. Analog TM circuits
8. Command and Digital TM circuits

These functions are individually described in the following sections. Schematics referenced in the following text are located at the end of this section. A more detailed block diagram is shown in Figure 3-2. This diagram includes pin connections, grounding data and interface connecting information. Figure 3-3 is the wiring diagram.

3.1 Video Output

A representation of the video output for one scan line is shown in Figure 3-4. An angular representation of one scan is shown in Figure 3.5. Both diagrams are referenced to the occurrence of the sync pulse which occurs at the start of the interval when the scan mirror views space just prior to the view of the earth.

3.2 Commands and Digital TM

Commands are received by the HCMR from the spacecraft as pulses of 40 millisecond duration on two isolated lines for each command. The command is stored by means of latching relays and digital command verification telemetry is outputted.

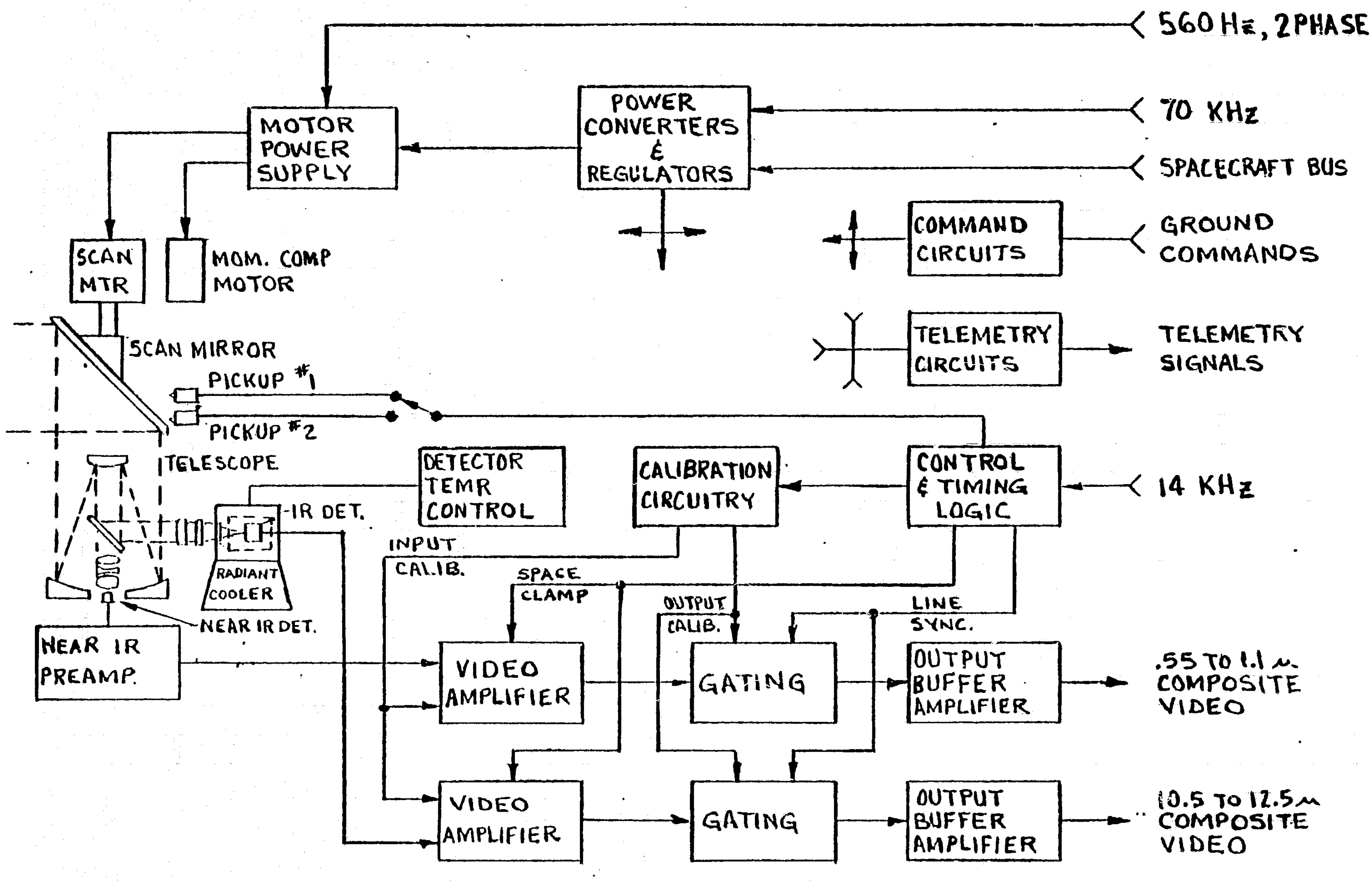
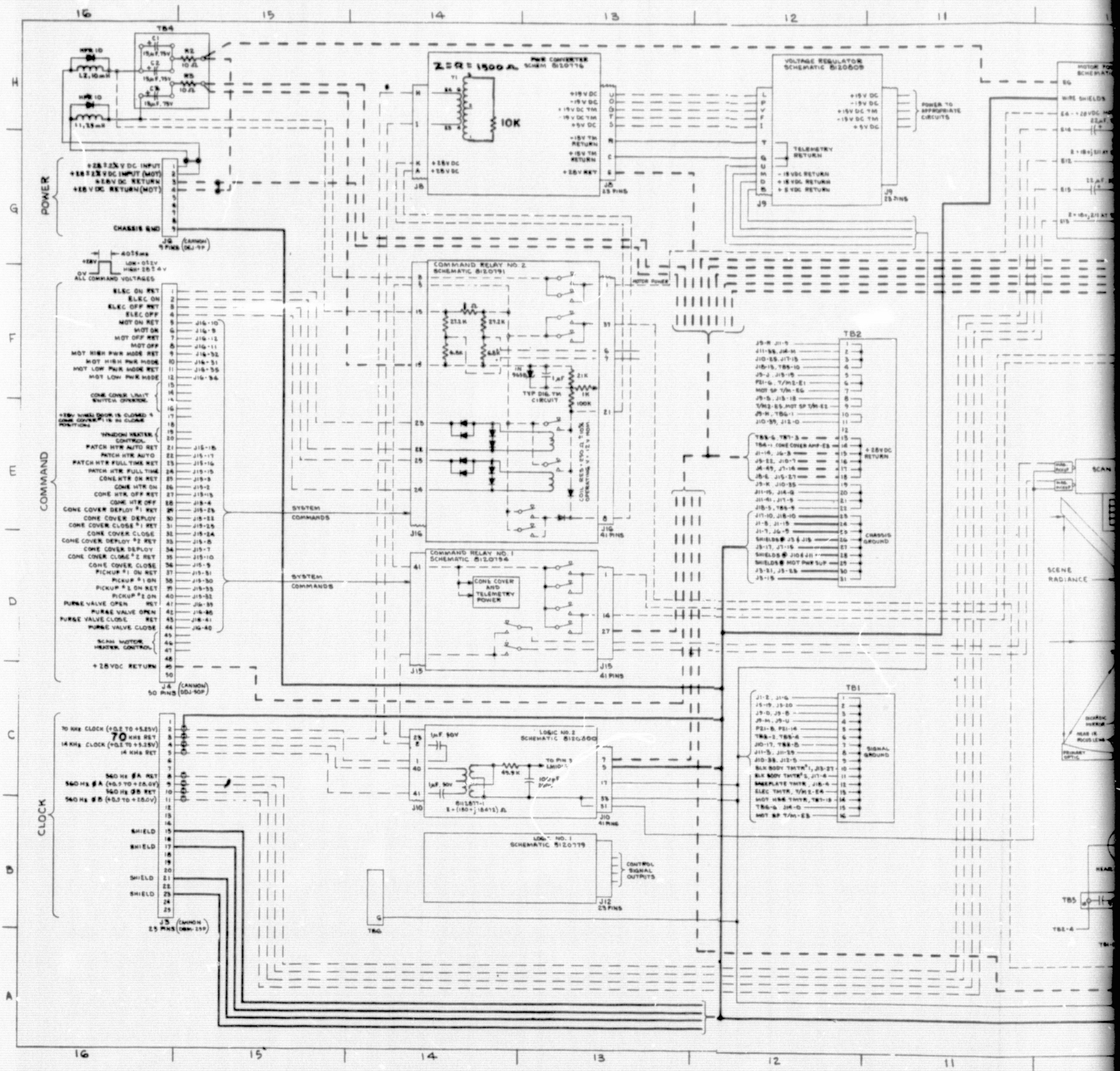


FIGURE 3-1 HCMR FUNCTIONAL BLOCK DIAGRAM



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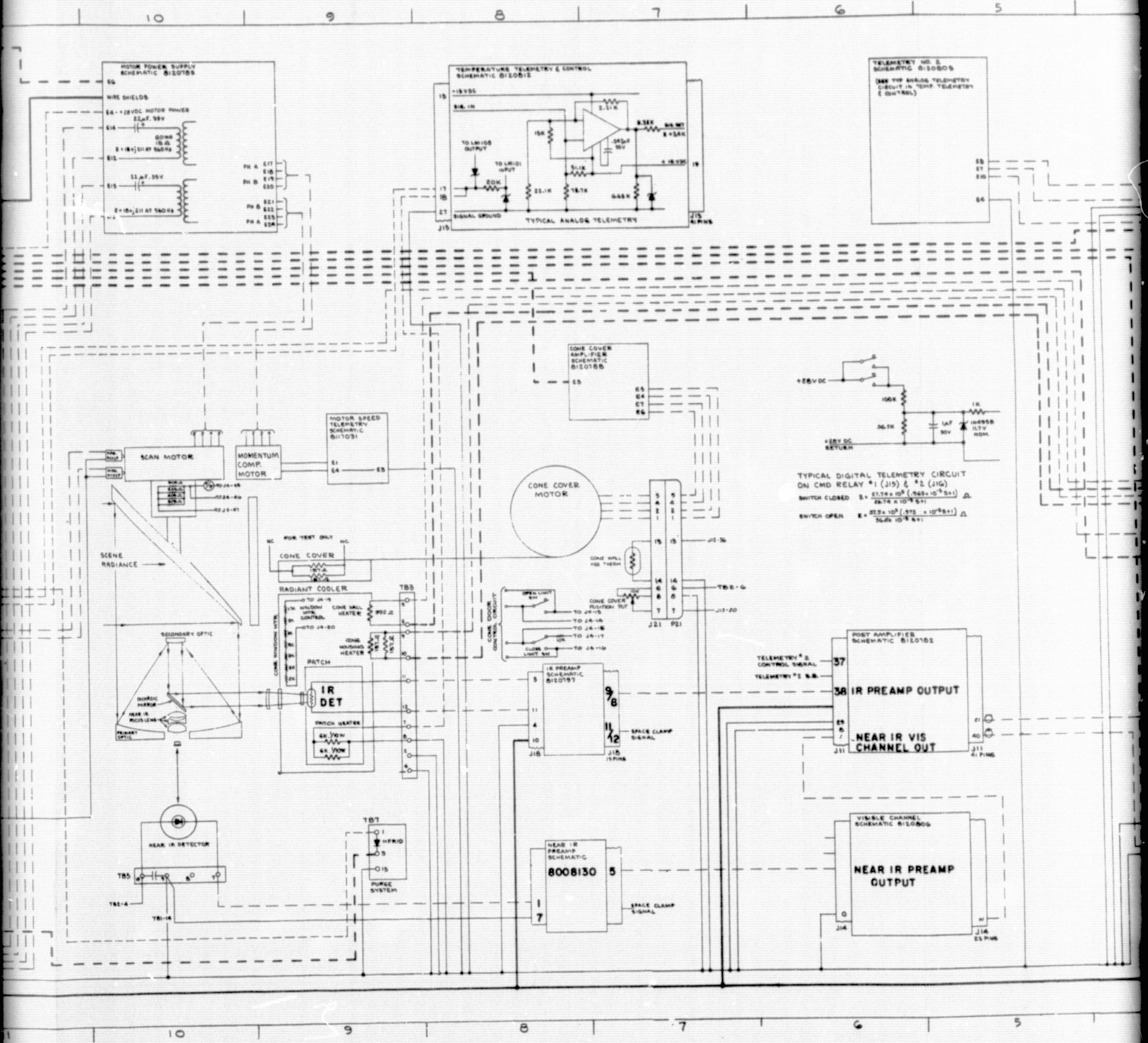

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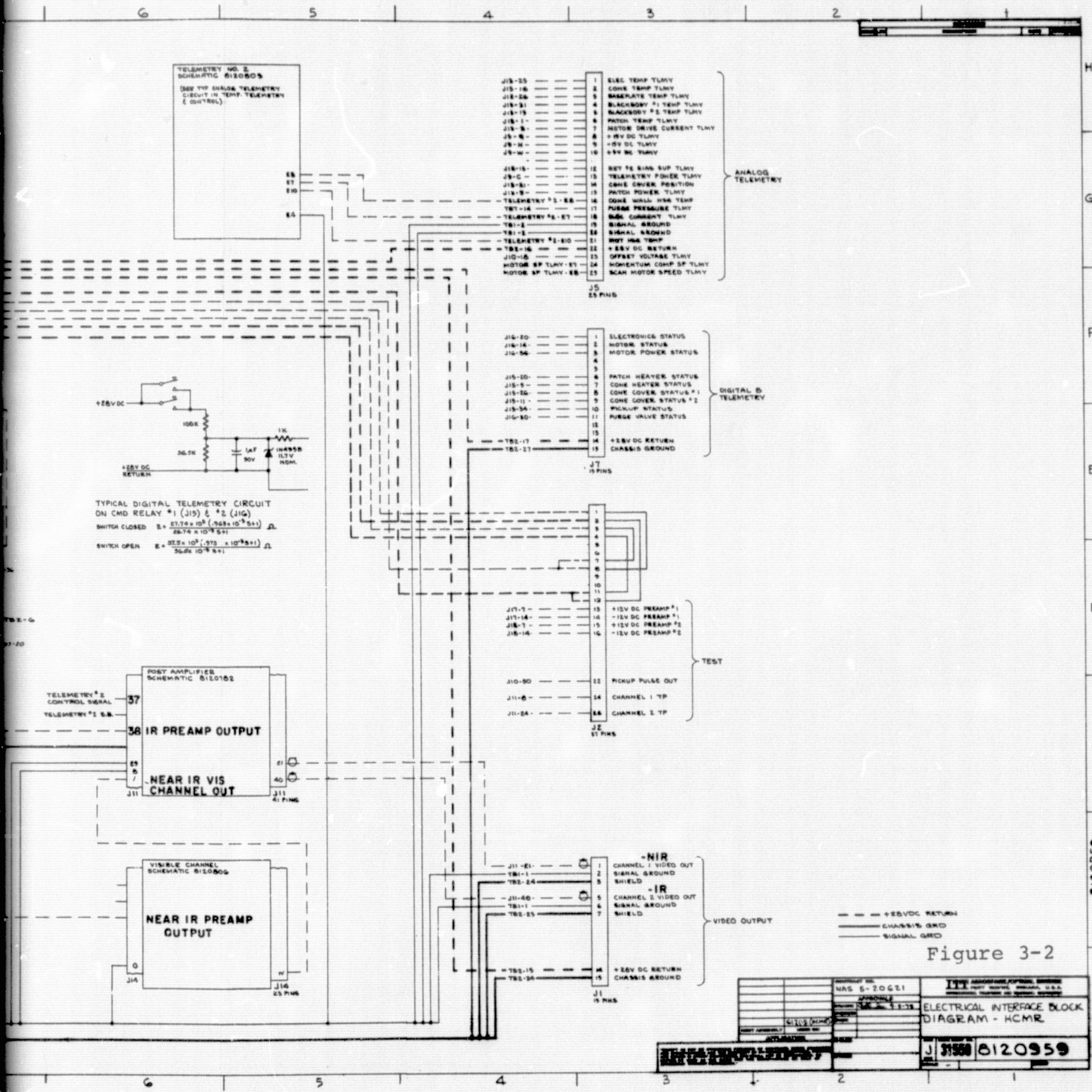

Figure 3-2

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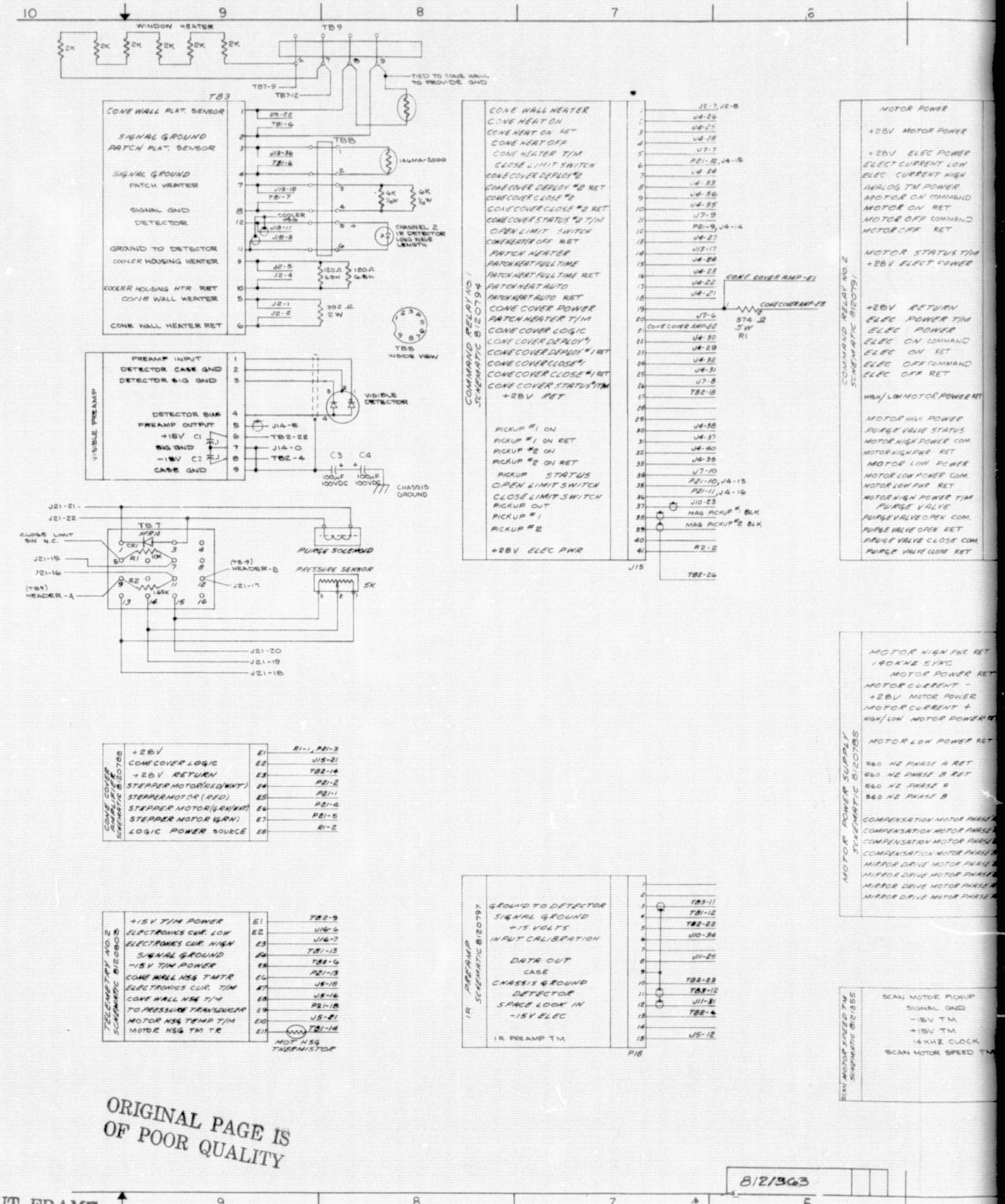

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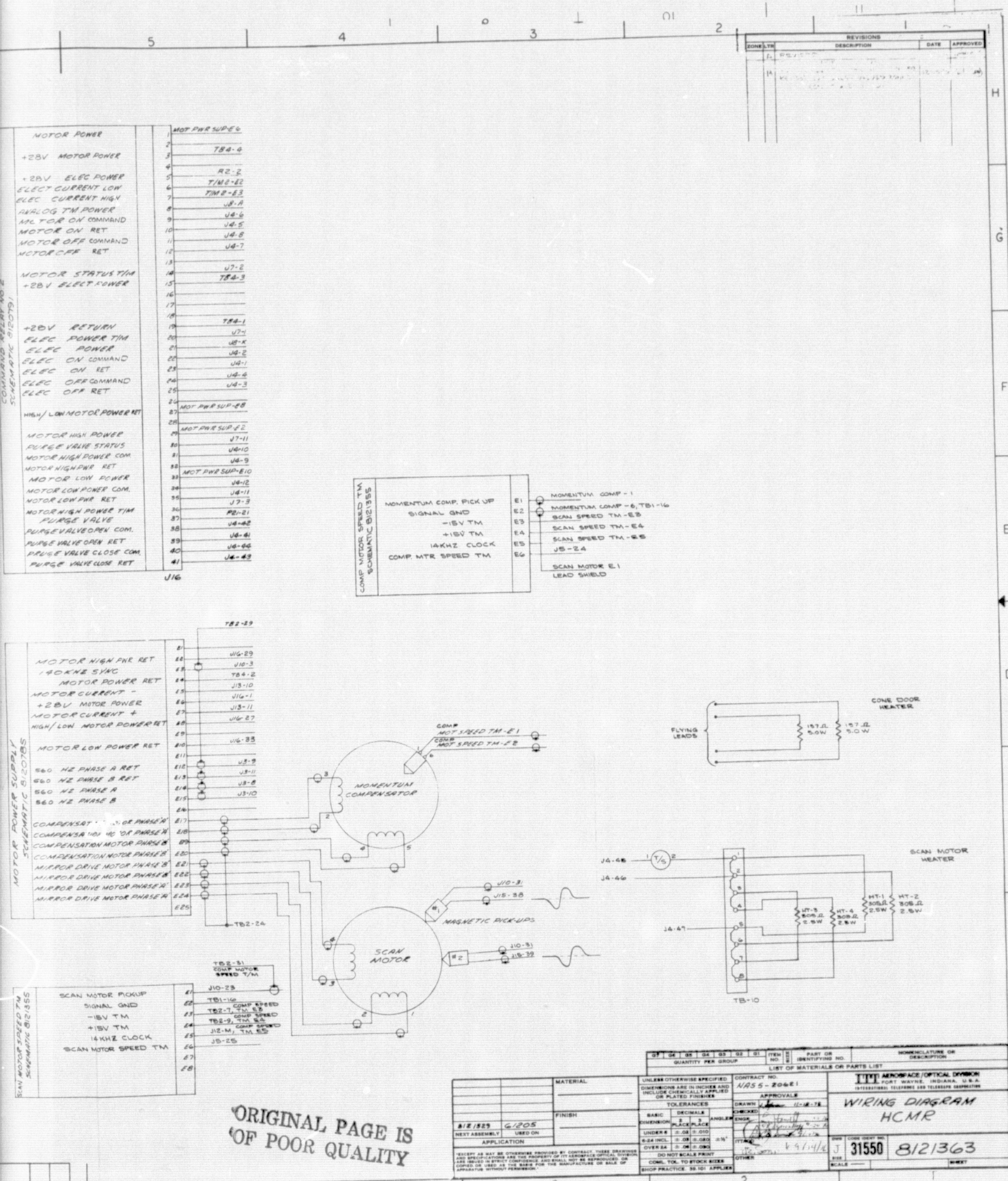

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Figure 3-3

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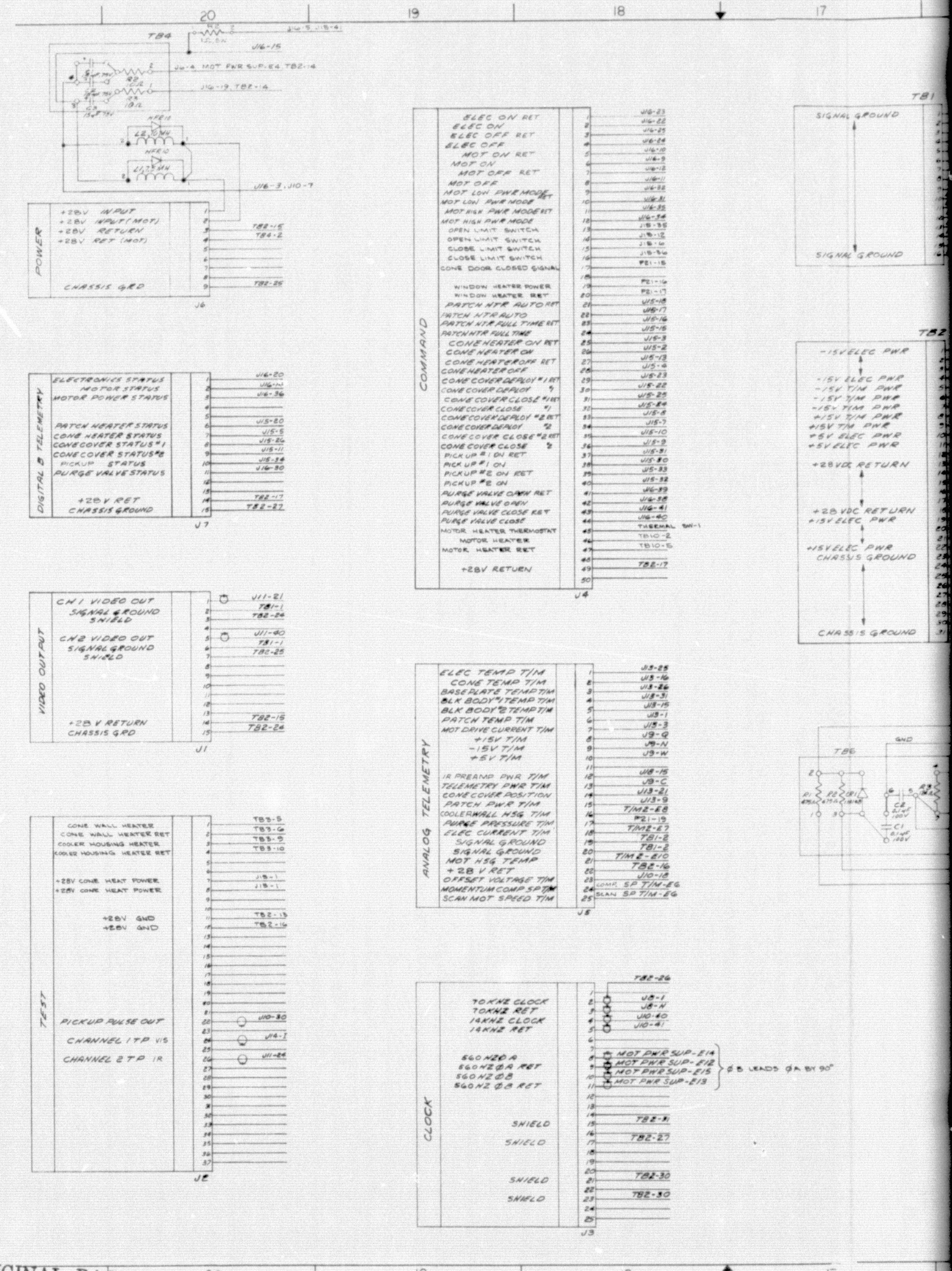

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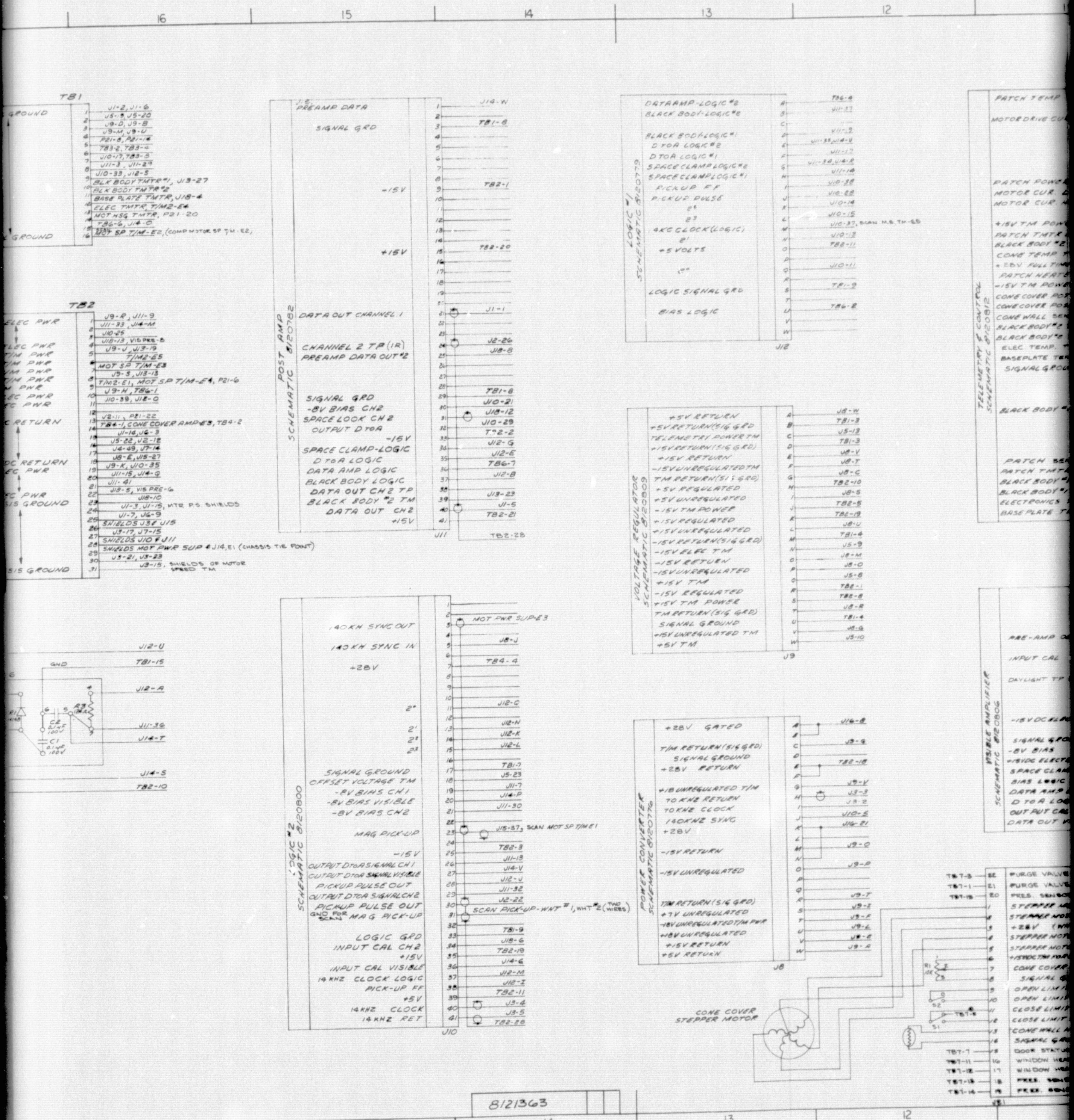

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Figure 3-3 (Contin

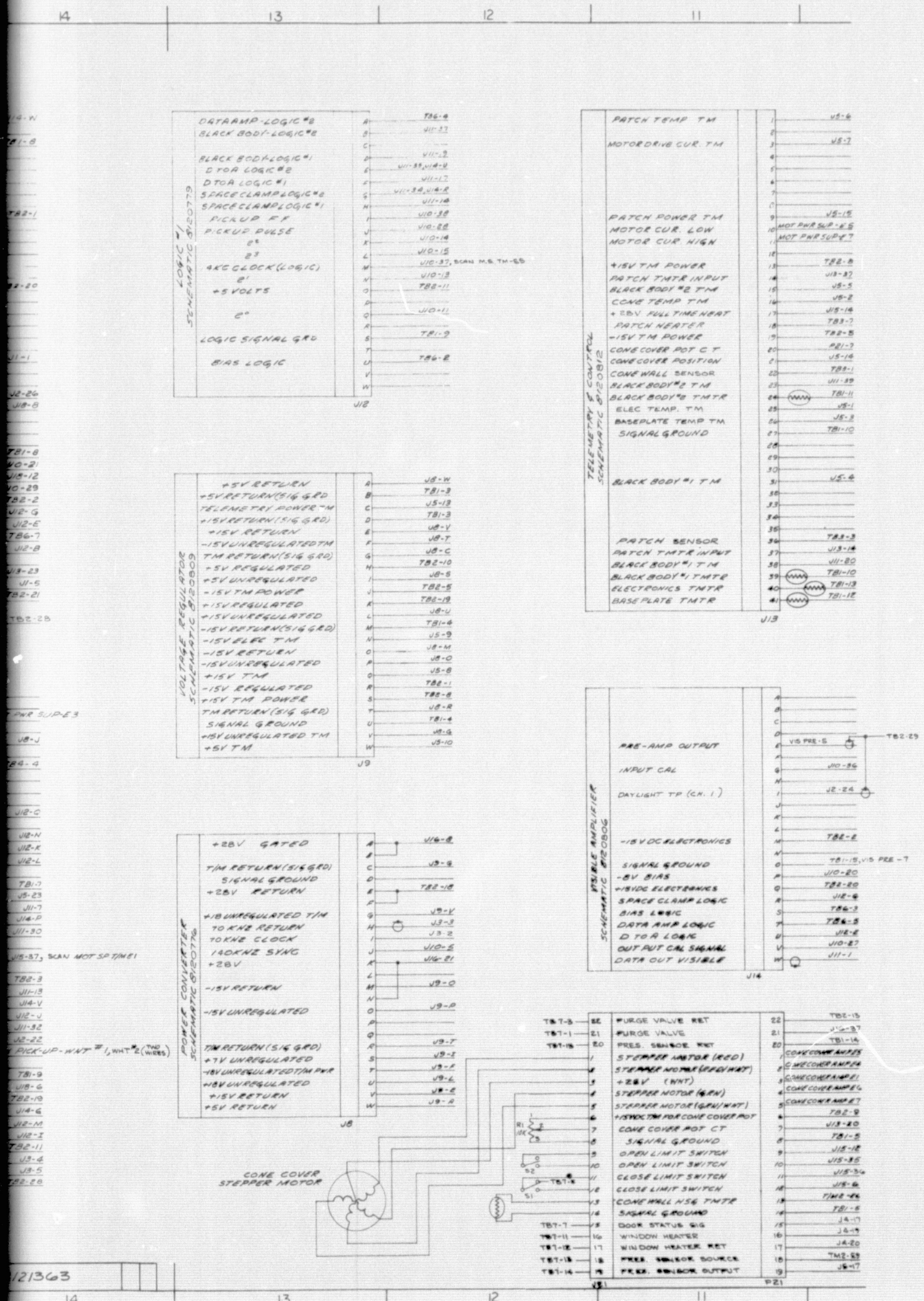

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Figure 3-3 (Continued)

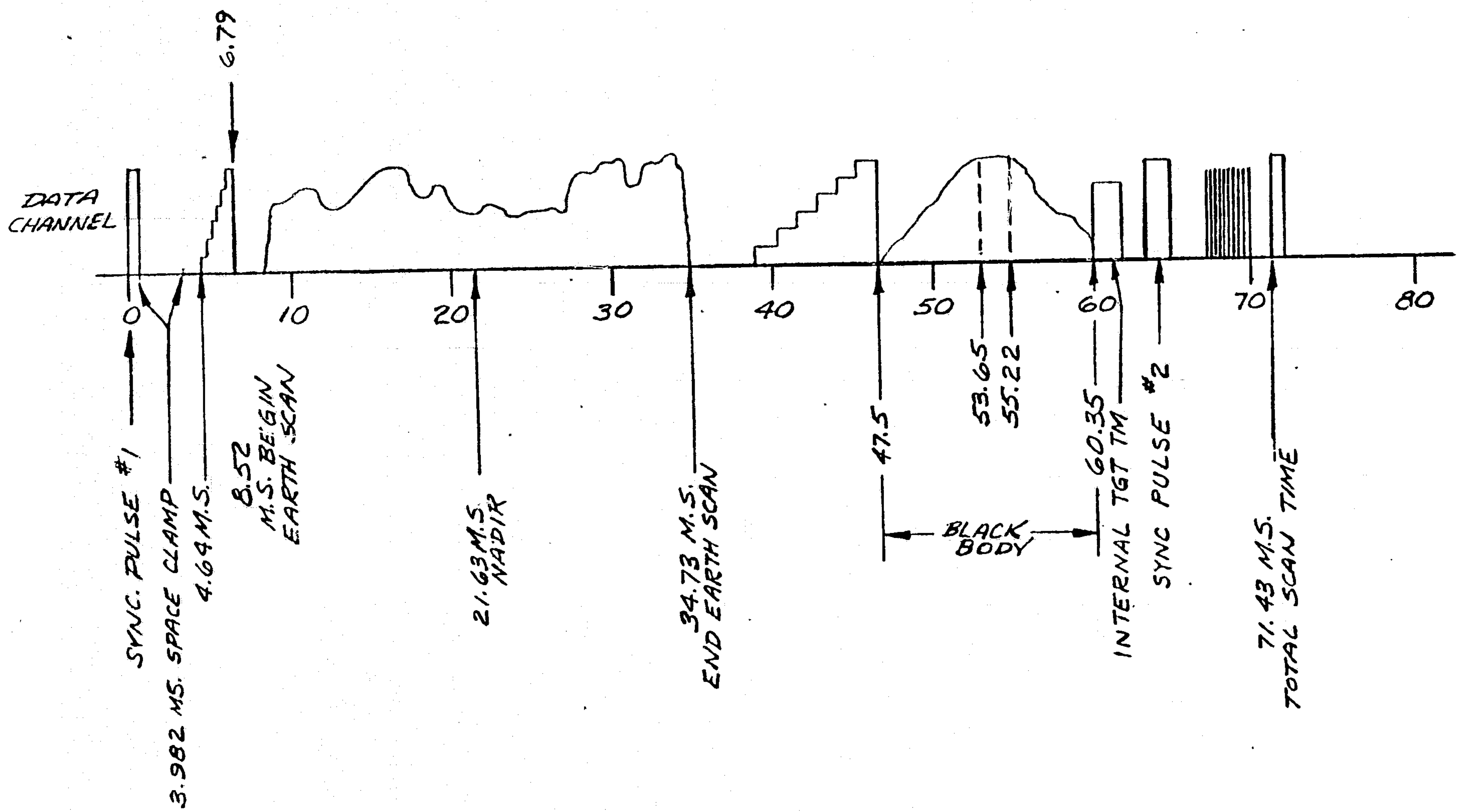


FIGURE 3-4 HCMR DATA FORMAT 10° TILT

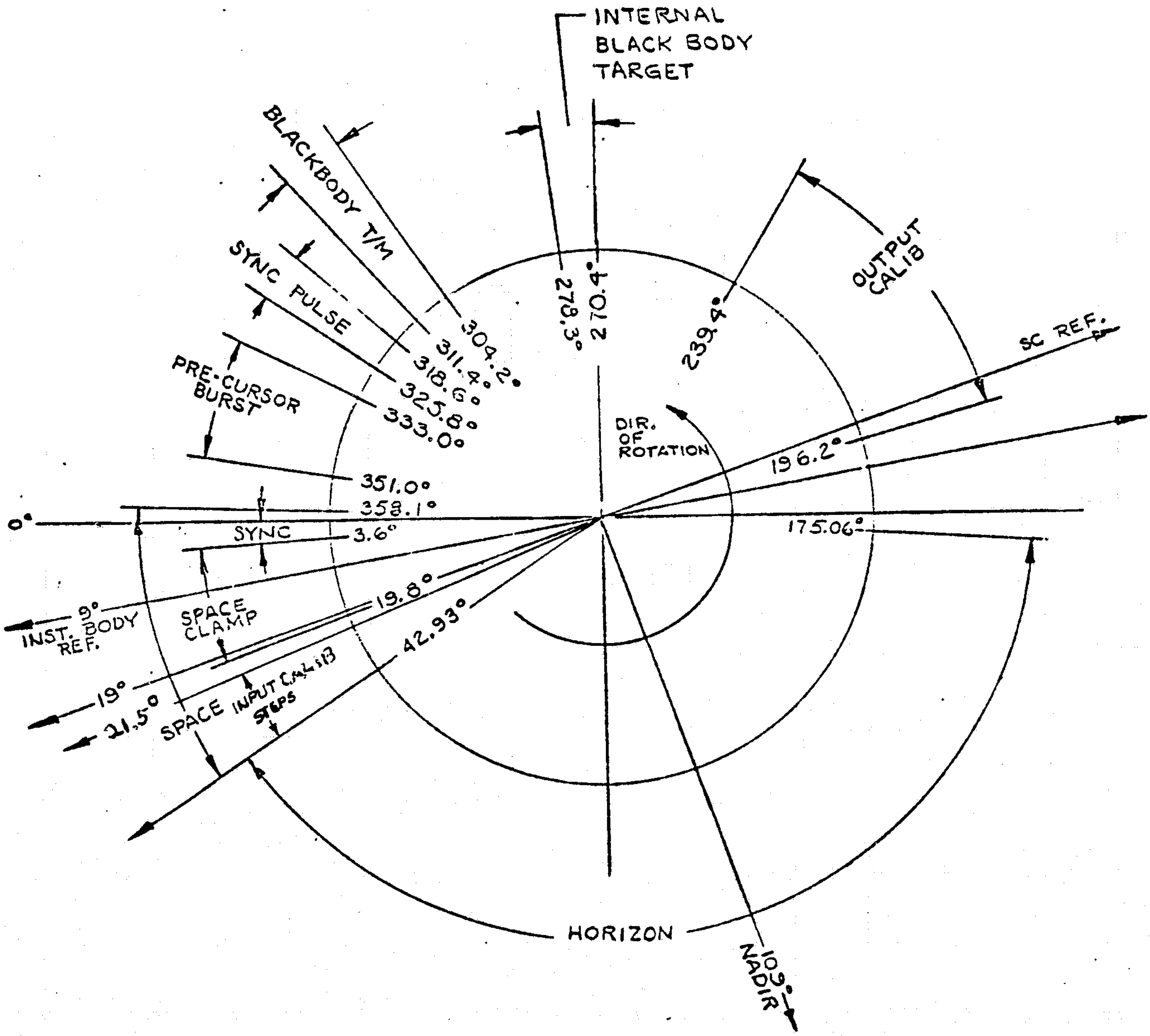


FIGURE 3-5 HCMR ANGULAR DATA FORMAT VIEW FROM REAR OF SCAN MOTOR

The schematics of the command system of the HCMR are shown on drawings 8120794 and 8120791.

The commands, their functions, and the telemetry response are as follows:

Motor ON/OFF - Applies DC power to the scan motor and momentum compensator. Turns on analog telemetry through the power converter. Motor ON is Logic 1.

Motor High/Low Power Mode - High power mode applies +28.0 VDC to Scan Motor P.S. Low Power Mode applies -15 VDC to Scan Motor P.S. through a switching regulator. Motor Low Power Mode is Logic 1.

Electronics ON/OFF - Applies power to the HCMR Electronics through the power converter. Also turns on the analog telemetry through the Power Converter. Electronics ON is Logic 1.

Purge Valve Open/Close - Applies +28.0 VDC to the HCMR purge system to release a flow of dry nitrogen gas around the patch. Purge Open is Logic 1.

Cone Heater ON/OFF - Applies +28.0 VDC to the heater on the cooler cone walls. Cone Heater ON is Logic 1.

Patch Heater Full Time/Automatic - Applies +28.0 VDC to the patch heater or select automatic patch temperature control. Patch Heat Full is Logic 1.

Pickup Status - Indicates whether Pickup #1 or #2 is activated. Pickup #1 is Logic 1.

Cone Cover Deploy/Close 1 & 2 - Duplicate Pair of commands. Both must be in the same state to cause operation. Applies +28 VDC to cone cover circuits to operate cooler door in commanded direction. Circuit removes +28 VDC load at completion of operation. Cone Cover Deploy is Logic 1.

3.3 Power Conversion Circuits

DC power for the HCMR Electronics is obtained by the Power Converter shown in Schematic 8120776. The clock signal for the converter is derived by AMP 1 operating as an oscillator. The 140 KHz oscillator is normally synchronized to the spacecraft 70 KHz clock. Two separate converter circuits are separately powered. One is used for the electronic circuits, the other is used for the Analog Telemetry circuits.

Linear regulator circuits for the DC power are shown in Schematic 8120809. Plus 15 volts, minus 15 volts, and plus 5 volts are provided for the electronics. Plus and minus 15 volts are provided for telemetry circuits.

3.4 HCMR Clock Signals

The HCMR normally operates with 70 KHz and 14 KHz spacecraft clock signals. The 70 KHZ clock is used to synchronize a 140 KHz oscillator in the power converter for power conversion. The 14 KHz clock is used for the logic timing functions.

In the event of the loss of the 14 KHz clock from the spacecraft, a clock detector circuit on the logic No. 2 board switches in a 14 KHz clock which is counted down from the 140 KHz power converter clock. This provides a 14 KHz clock timing signal which is synchronous to the spacecraft 14 KHz clock but not coherent to it.

In the event of the loss of the 70 KHz clock line, the power converter oscillator will continue to operate at a frequency near 140 KHz. The logic timer clock will continue to operate from the spacecraft 14 KHz clock line as long as it is present.

With the loss of both clock lines the HCMR will continue to operate but internal timing will be a function of the internal oscillator. The scan period, however, will be maintained as long as the 560 Hz clock to the scan motor is maintained.

3.5 Logic Clock

The timing and control functions of the HCMR are shown on Schematics for Logics No. 1, drawing 8120779, and Logic No. 2, drawing 8120800.

The 14 KHz spacecraft clock enters at pins 40 and 41 of the Logic No. 2 board. AMP 1 functions as a receiver and a shaping circuit. Positive feedback supplied by R2 and R3 provide controlled hysteresis of this circuit to provide immunity from the noise occurring during the transition causing multiple triggering. Transistor Q1 and associated components provide an AC coupled detection circuit. A positive voltage across R26 provides a logic 1 input at pin 5 of U12 which gates in the clock output of AMP 1. The absence of this signal gates in the output of the divide by 10 counters comprised of U7 through U10. The selected clock appears at the output of the OR gate at U12, pin 3. The gating of the U1 and the status of FFU2 determine the phase of the clock which appears at pin 37 for use by the scan counter.

The negative going transition of the clock at pin 37 triggers the monostable U4. The transition of the pick-up signal to initiate scan timing triggers monostable U5. If these transitions occur within 10 microseconds of each other, the combined signal will reverse the state of Flip-Flop U2, causing the opposite phase of the 14 KHz clock to be present at pin 32. This is done to prevent the clock edge which advances the scan counter to occur near the sync pulse so that scan motor jitter will not come a continuous 71.43 microsecond jitter in the timed calibration signals.

3.6 Logic Timing & Control

The logics for controlling the gating signals for the HCMR scan timing are shown on 8120779 - Schematic Logics No.1.

The time base for the scan count is the 14 KHz clock from the Logic No. 2 board which is under normal operation the spacecraft 14 KHz clock signal. Flip-Flop 1,2, and 3 are a divide by five counter to give a 2.8 KHz time base for decoding. Flip-Flops 4 through 11 are connected as a conventional binary ripple counter. The counter is present to a 8.2 millisecond count to allow proper sequence of counter operation for the staircase input and output calibration signals at the required times. Weighted input calibration signals are obtained from Flip-Flops 4 through 7 while output calibration is derived from Flip-Flops 6 through 8.

The counter string is held in a reset condition by the toggle composed of NAND 1 and NAND 2. The reset is removed by a negative going pick-up pulse signal at NAND 16 through NAND 47. The count continues for 69.6 milliseconds when the reset is again applied.

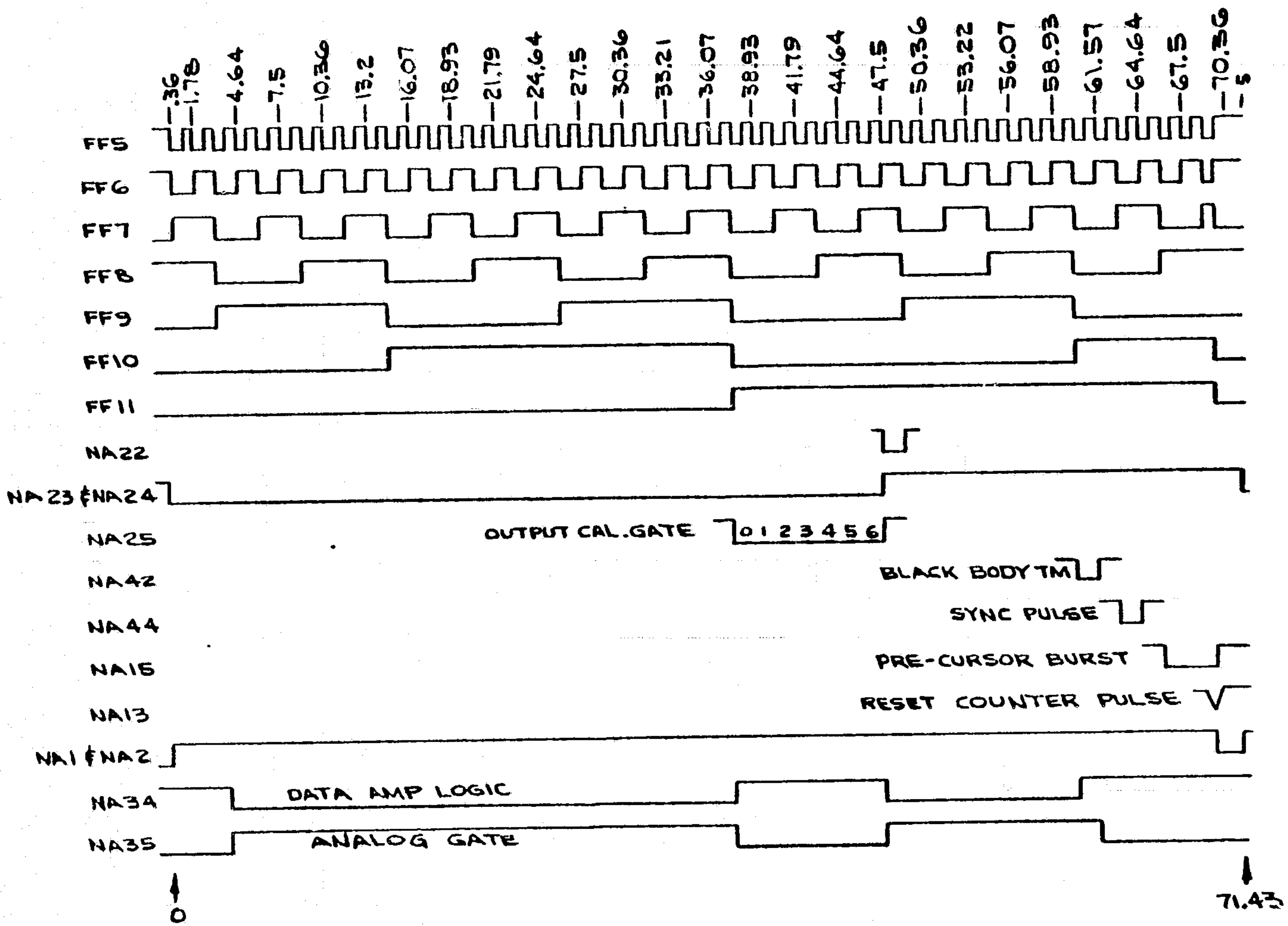
The gating outputs from the logics are the five signals:

1. Space Clamp
2. Data Amp Logic
3. Black Body Logic
4. Analog Gate
5. Visible Bias Gate

Space Clamp causes a sample of the Video Amplifier output to be taken for zero reference correction. Data Amp logic causes the output of the Video Amplifier for each stage to be connected to the output driver. Blackbody logic gates the Blackbody TM signals to output driver in the IR Channels. The Analog Gate signal gates the D to A output to the output Driver. The Visible Bias Gate gates in a 3 volt offset during input calibration time on the Visible channel since the output calibration signals are set up to normally operate in the IR channel which are offset by 3 volts. A zero logic level on these outputs is the level which causes the stated operation.

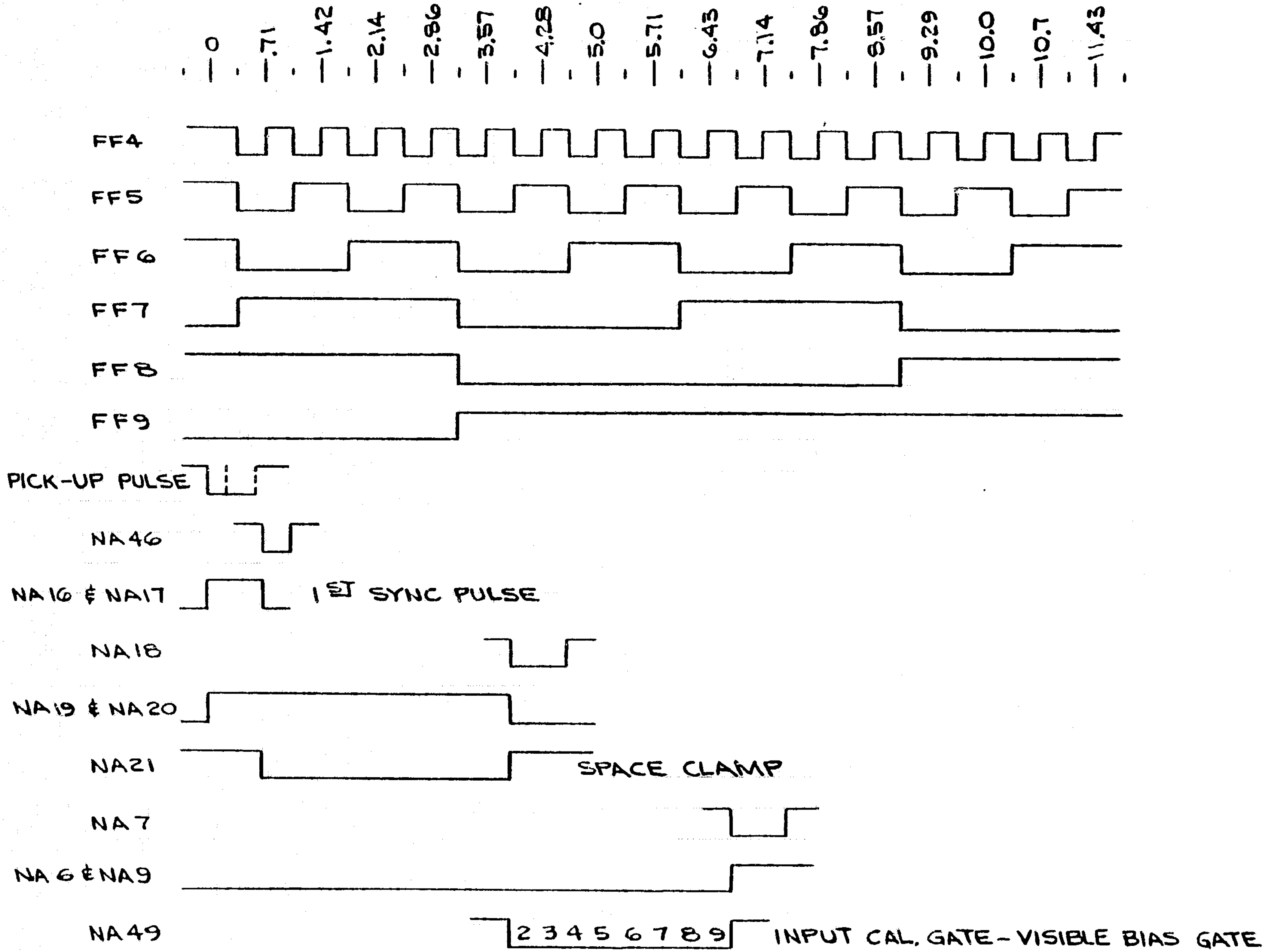
Four logic Levels which are the inputs to the D to A converter are also generated. Table 3-1 shows the signal source and time intervals for these signals.

The timing for the gating and calibration signals are shown in Figures 3-6 and 3-7.



HCMR LOGIC TIMING

FIGURE 3-6



HCMR LOGIC TIMING

FIGURE 3-7

Table 3-1

D to A Logic Control Signals

Name	Time	Signal	Signal Path	Binary Weight
Sync	0 - .714 msec	6 V	FF(NA16 & NA17)-NA45-NA28-NA36	2^1
			FF(NA16 & NA17)-NA45-NA29-NA38	2^2
Input Cal.	3.93 to 6.79 msec	2V thru 9V	FF - NA - NA37	2^0
			FF5 - NA9 - NA36	2^1
			FF6 - NA11 - NA38	2^2
			FF7 - NA48 - NA12 - NA39	2^3
Output Cal.	37.5 to 47.5 msec	0 V to 6 V	FF6 - NA30 - NA37	2^0
			FF7 - NA48 - NA32 - NA36	2^1
			FF8 - NA33 - NA38	2^2
Sync #2	63.21 to 64.64 millsec	6 V	NA44 - NA45 - NA28 - NA36	2^1
			NA44 - NA45 - NA24 - NA38	2^2
Pre-cursor	66.07 to 69.64 msec	6 V modulated by 14 Kh	NA4 - NA27 - NA45 - NA28 - NA36	2^1
			NA4 - NA27 - NA45 - NA29 - NA38	2^2

3.7 IR Data Amplifiers

The IR data amplifiers are physically divided into two sections; the IR preamplifier which is individually packaged, and mounted to the cooler housing, and the Post Amplifier which is located in the Electronics Box.

3.7.1 IR Preamplifier

The schematic for the IR Preamplifier is shown on drawing 8120797. The preamplifier has its own plus and minus 12 volt regulators to provide isolation from the HCMR plus and minus 15 volt electronics supplies. In addition, the -12 volt supply is compensated to maintain a constant voltage over the ambient temperature range. The temperature varying voltage drop of diode CR6 is divided down by R33 and R34. The voltage drop across R34 modifies the voltage at pin 1 of the LM104 regulator to compensate for its voltage variation with temperature. The circuit is tailored and tested to maintain a voltage which will vary less than ±0.1% over greater than the expected ambient temperature conditions.

The detector bias is determined by the value of the R15 and the -12 volt supply. The fact that detector responsivity is almost a linear function of the bias is the reason for the care taken for

the stability of the -12 volt power source. Resistor R15 is a stable resistor with a temperature coefficient of 2 ppm.

The input circuit for the IR preamplifier is a differential pair. Transistor Q2 provides a constant current source for Q3 and Q4. The detector is the only signal input at the base of Q3. Feedback from the output of amplifier AMP 1 which is a portion of the first amplifier stage, feedback from space look for DC stablization from amplifier AMP 3, and input calibration signals are summed at R7 at the base of Q4. A DC bias through resistor R17 is also summed at this point. The value of R17 is chosen to allow amplifier AMP3 to operate at approximately 0 volt output to allow for maximum space look correction margin and to set operation at minimum output offset.

Amplifier AMP2 is a conventional inverting amplifier stage with a gain of approximately 5.

Capacitor C11 stores the output of the data amplifier prior to the 3 volt offset at the time the scan mirror views space. Amplifier AMP 4 is a unity gain non-inverting stage with high input impedance for buffering to the following stage. Amplifier AMP 3 is a low pass filter stage with a very low high frequency cut-off as determined by C9 and R27 and a DC gain of 220. R28 and C10 comprise a lead network for stability to prevent over-correction for scan to scan sample differences.

The individual amplifier stages provide essentially flat response beyond 52.3 KHz so that the frequency response is determined by the filter network in the Post Amplifier.

The input calibration signal at terminal E6 is attenuated by the network comprised of R20, R21, R22 and R23. These values are tailored after the amplifier gain is determined to provide the 1 Volt input calibration steps.

3.7.2 IR Post Amplifier

The schematic of the post amplifiers is shown on drawing 8120782.

Amplifier AMP 1 is a conventional inverting amplifier with a gain of approximately 5. R5, L1, C4, L2, C5, and R6 comprise a linear phase filter for noise attenuation. Amplifier AMP 2 is a non-inverting stage with a gain of 5. The output of AMP 2 is the full value output of the channel prior to the insertion of the 3 volt offset and as such has a full scale output of +9 volts.

The output of this stage is sampled through R10 across CR1 and CR2 at the time the scan mirror is viewing space. CR1 and CR2 are used to limit the feedback signal at turn on before the amplifier chain stabilizes. Limiting the signal in this manner allows better response in the space look feedback loop during normal

operation. U1 and U2 are dual FET switches assemblies with logic compatible drivers. One section of U2 (pins 12 and 13) gates the output to the preamplifier.

Amplifiers AMP3 and AMP4 are a driver stage with an inverting gain of unity and a non-inverting gain of two. Amp 3 is a voltage amplifier and Amp 4 is a unity gain current driver provided to drive the output line capacitance. One section of U1 gates the output of AMP 2 (Video) to the inverting input of AMP 3 (pins 12 and 13). A DC offset signal through R12 and R13 provide a signal to offset the video output by -3 volts. The offset voltage at pin 7 and the values of R12 and R13 are tailored to provide a current to the summing point equal to the current of a 3 volt signal through feedback resistor R17. Diode CR4 blocks all positive going signals. Diode CR3 provides a low impedance feedback path for positive signals to prevent amplifier input saturation. This clipping action with the current bias provides a 0 Volt to +6 Volt output for signals which correspond to the +3 volt to +9 volt signals at the output of AMP 2.

Output calibration signals are switched in through U2 (pins 10 and 9). Blackbody TM signals are switched in through U1 (pins 10 and 9). Each is attenuated by a factor of 2 due to the gain of 2 of the output stages operating in the non-inverting mode. The two sync pulses and the 14 KHz pre-cursor burst are 6 volt levels from the D to A on the Output Calibration line and are switched in at the appropriate times under logic control.

3.7.3 Visible Amplifier

The visible channel preamplifier is shown on Schematic 8008130. The Visible Channel Amplifier is shown on Schematic 8120806. The silicon photodiode is operated with reverse bias as a current source to inverting input of the HA 2620 operational amplifier.

The Visible Channel Amplifier for the Visible Channel is identical in operation to the IR Post Amplifier. The zero reference feedback circuits utilizing a sample of amplifier output while viewing space are identical to the equivalent circuits in the IR Preamplifier. The Schematic is 8120806.

3.7.4 Motor Power Supply

The Power Supply for the HCMR Scan and Momentum Compensator motors (Schematic 8120785) is a conventional bridge switching amplifier. The circuit for the Momentum Compensator is powered from the +28 Volt bus. The circuits for the scan motor can be powered directly from the bus or from the switching regulator which supplies +18 VDC. Base drive for the switching transistors is derived from the spacecraft 560 Hz 2-phase clock through an isolation transformer.

3.8 Analog Telemetry

The HCMR Analog Telemetry signals together with board locations are listed below:

Signal	Circuit Location	
Electronics Temperature	Temp Tel and Control	(8120812)
Baseplate Temperature	Temp Tel and Control	
Blackbody No. 1 Temperature	Temp Tel and Control	
Blackbody No. 2 Temperature	Temp Tel and Control	
Cone Wall Temperature	Temp Tel and Control	
Patch Temperature	Temp Tel and Control	
Patch Heat	Temp Tel and Control	
Motor Current	Temp Tel and Control	
Cone Cover Position	Temp Tel and Control	
Electronics Current	Telemetry No. 2	(8120803)
Purge Pressure	Telemetry No. 2	
Cone Wall Housing	Telemetry No. 2	
Motor Housing Temperature	Telemetry No. 2	
Momentum Compensator Speed	Motor Speed TM	(8121355)
Scan Motor Speed	Motor Speed TM	
+15 Volt Electronics Supply	Voltage Regulator	(8120809)
-15 Volt Electronics Supply	Voltage Regulator	
+5 Volt Electronics Supply	Voltage Regulator	
-15 Volt TM Supply	Voltage Regulator	
Patch Power (heat)	Temp Tel & Control	(8120812)
Preamp Power	Ch. 2 Preamplifier	(8120797)
Offset Bias Voltage	Logic No. 2	

3.9 Calibration Signals

The input and output calibration signals are generated by the Digital to Analog Converter V6 on the Logic No. 2 Board. This device is one-half of a basic 8 bit device with an accuracy of ± ½ LSB. The reference voltage for the D to A is supplied by negative voltage regulator REG 1. This device is temperature compensated to a stability of ±0.1% in the same manner as those in the IR Preamplifiers. This stabilized regulator is also used as the source voltage for the 3 volt offset in the data amplifiers. Separate amplifiers are provided for input and output calibration outputs. Tailoring resistors for output calibration for each channel are provided on the Logic No. 2 board.

3.10 Cone Cover Amplifier (8120788)

This circuit controls the opening and closing of the radiant cooler cone door. Schematic 8120788 depicts the cone cover amplifier. It consists of an oscillator composed of Amp 1 and its peripheral components. The oscillator operates at a nominal 53 Hz. The oscillator signal is buffered by U1 which is 1 section of a 949 gate. The signal is sent to U2, a 945 flip-flop, and counted down by 2. The 2 outputs of U2 again are

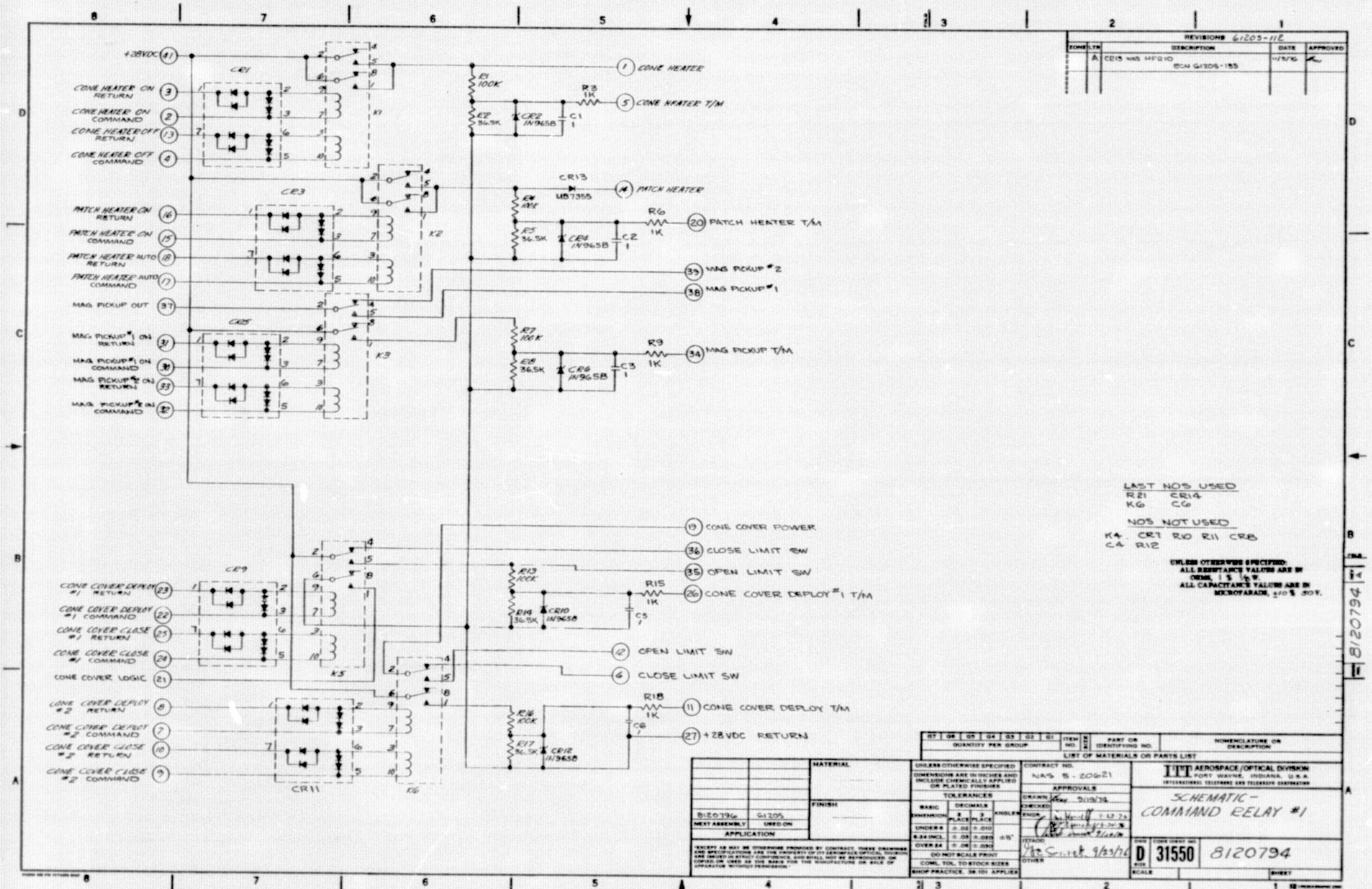
counted down by U3 another 945 flip-flop. The two signals from U3 are of opposite phase and a nominal 75 MS duration. After buffering by U7 these signals drive the 2N4150, transistors Q1 and Q2 which are connected to two of the cone door motor windings.

The other output of U2 drives U4 and since the 945's only trigger when the voltage goes low, U4 will be out of phase with U3 by 90^0. The two outputs of U4 after buffering by U8 drive Q3 and Q4 which are connected to the other two windings of the cone door stepper motor.

The combination of U6, a monostable multivibrator and one section of gate U1 with 3 sections of gate U5, have the ability to set or clear U3, thus reversing the phase of the Ø 1 outputs. This occurs whenever a command appears at E2. A 1 at E2 allows an output from pin 3 of U5 when U6 goes low clearing U3 and setting up the door-close phase conditions. A zero at E2 allows an output from U5 pin 11 and sets U3 when U6 goes low and sets up the door- deploy phase condition.

3.11 <u>Motor Speed TM (8121355)</u>

This circuit determines the speed of the scan or compensating motor. Two identical circuits are used in the instrument. The 14 KHz clock is buffered by Q1 and activates the 2-4 bit counters U2 and U3. These counters connected in series continue to count 256 until disabled by a shaped pulse from the magnetic pickup located in the motor housing cover. The leading edge of the shaped pickup pulse gates U4 and U5 allowing the count on U2 and U3 to be stored in registers U4 and U5. The resistor network converts this digital signal to an analog voltage proportional to the time for one revolution of the scan mirror. The trailing edge of the shaped pickup pulse resets U2 and U3 and the sequence begins again. The pickup pulses are detected, shaped, and amplified by Amp 1 and buffer U1. The speed sensitivity is 0.84 RPM.



REVISIONS 61205-112
ZONE | LTR | DESCRIPTION | DATE | APPROVED
A | CR13 WAS HF210 ECN 61205-155
+28VDC 41
CR1
CONE HEATER ON RETURN 3
CONE HEATER ON COMMAND 2
CONE HEATER OFF RETURN 13
CONE HEATER OFF COMMAND 4
K1
1 CONE HEATER
R1 100K
R2 36.5K
CR2 1N965B
C1 1
R3 1K
5 CONE HEATER T/M
CR3
PATCH HEATER ON RETURN 16
PATCH HEATER ON COMMAND 15
PATCH HEATER AUTO RETURN 18
PATCH HEATER AUTO COMMAND 17
K2
CR13 UES7355
14 PATCH HEATER
R4 100K
R5 36.5K
CR4 1N965B
C2 1
R6 1K
20 PATCH HEATER T/M
39 MAG PICKUP #2
38 MAG PICKUP #1
MAG PICKUP OUT 37
CR5
MAG PICKUP #1 ON RETURN 31
MAG PICKUP #1 ON COMMAND 30
MAG PICKUP #2 ON RETURN 33
MAG PICKUP #2 ON COMMAND 32
K3
R7 100K
R8 36.5K
CR6 1N965B
C3 1
R9 1K
34 MAG PICKUP T/M
LAST NOS USED
R21 CR14
K6 C6
NOS NOT USED
K4 CR7 R10 R11 CR8
C4 R12
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, 1% 1/8W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ±10% 50V.
19 CONE COVER POWER
36 CLOSE LIMIT SW
35 OPEN LIMIT SW
CR9
CONE COVER DEPLOY #1 RETURN 23
CONE COVER DEPLOY #1 COMMAND 22
CONE COVER CLOSE #1 RETURN 25
CONE COVER CLOSE #1 COMMAND 24
K5
R13 100K
R14 36.5K
CR10 1N965B
R15 1K
C5 1
26 CONE COVER DEPLOY #1 T/M
CONE COVER LOGIC 21
12 OPEN LIMIT SW
6 CLOSE LIMIT SW
CONE COVER DEPLOY #2 RETURN 8
CONE COVER DEPLOY #2 COMMAND 7
CONE COVER CLOSE #2 RETURN 10
CONE COVER CLOSE #2 COMMAND 9
CR11
K6
R16 100K
R17 36.5K
CR12 1N965B
R18 1K
C6 1
11 CONE COVER DEPLOY T/M
27 +28 VDC RETURN
G7 G6 G5 G4 G3 G2 G1
QUANTITY PER GROUP
ITEM NO.
SIZE
PART OR IDENTIFYING NO.
NOMENCLATURE OR DESCRIPTION
LIST OF MATERIALS OR PARTS LIST
8120796 | 61205
NEXT ASSEMBLY | USED ON
APPLICATION
MATERIAL
FINISH
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES
TOLERANCES
BASIC DIMENSION | DECIMALS 2 PLACE | 3 PLACE | ANGLES
UNDER 6 | ±.02 | ±.010 | ±1/2°
6-24 INCL. | ±.03 | ±.020
OVER 24 | ±.06 | ±.030
DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE 38.101 APPLIES
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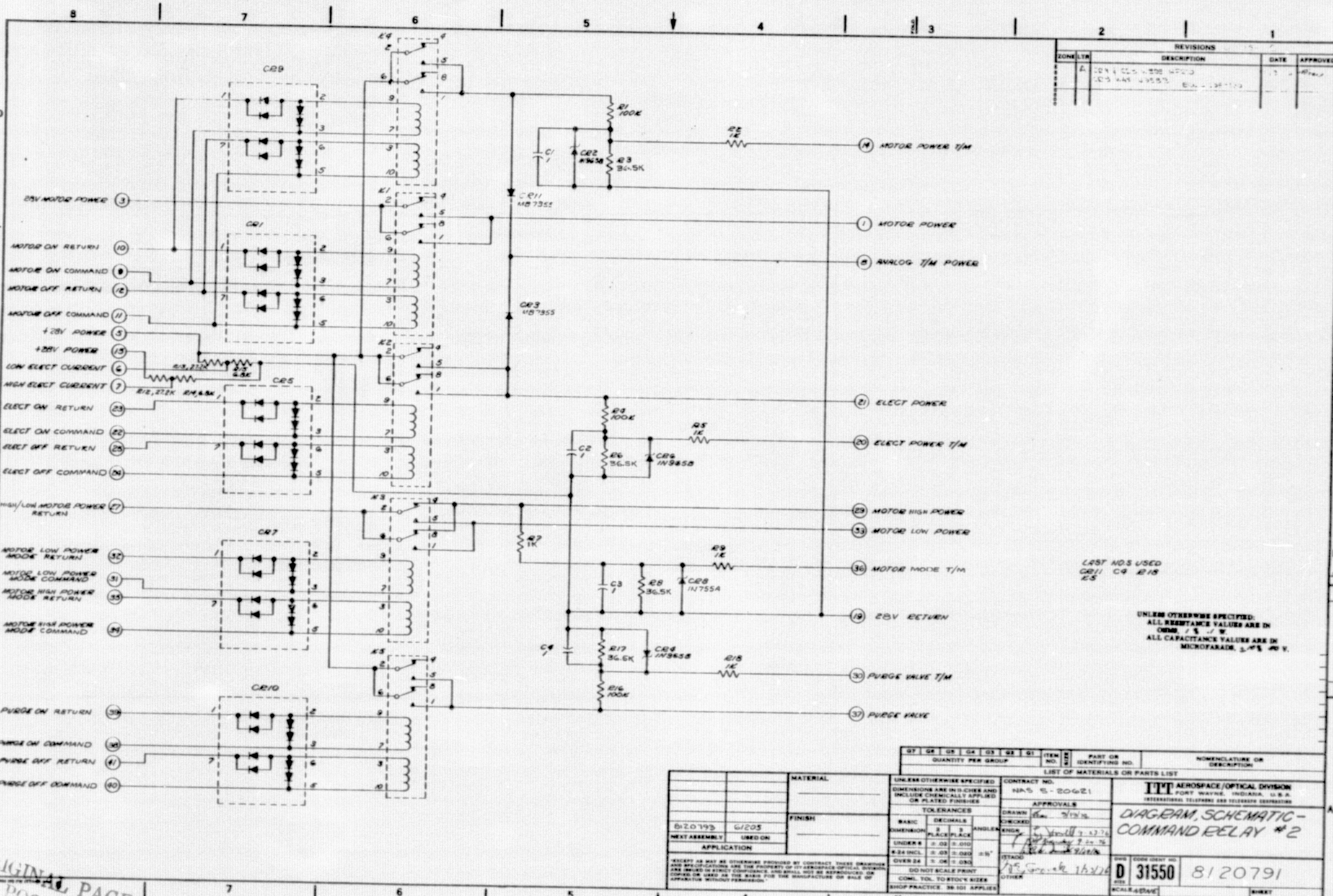
CONTRACT NO. NAS 5-20621
APPROVALS
DRAWN 9/19/74
CHECKED
ENGR
ITTAOD
OTHER
ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
SCHEMATIC - COMMAND RELAY #1
D 31550 8120794
SCALE
SHEET
8120794


CR9
CR1
CR5
CR7
CR10
K4
K1
K2
K3
K5
28V MOTOR POWER (3)
MOTOR ON RETURN (10)
MOTOR ON COMMAND (9)
MOTOR OFF RETURN (12)
MOTOR OFF COMMAND (11)
+28V POWER (5)
+28V POWER (15)
LOW ELECT CURRENT (6)
HIGH ELECT CURRENT (7)
ELECT ON RETURN (23)
ELECT ON COMMAND (22)
ELECT OFF RETURN (25)
ELECT OFF COMMAND (24)
HIGH/LOW MOTOR POWER RETURN (27)
MOTOR LOW POWER MODE RETURN (32)
MOTOR LOW POWER MODE COMMAND (31)
MOTOR HIGH POWER MODE RETURN (35)
MOTOR HIGH POWER MODE COMMAND (34)
PURGE ON RETURN (39)
PURGE ON COMMAND (38)
PURGE OFF RETURN (41)
PURGE OFF COMMAND (40)
R1 100K
R2 1K
R3 36.5K
C1 1
CR2 IN965B
CR11 MB7355
CR3 MB7355
R13, 27.2K
R11 4.8K
R12, 27.2K
R14, 4.8K
R4 100K
R5 1K
R6 36.5K
C2 1
CR6 IN965B
R7 1K
R9 1K
C3 1
R8 36.5K
CR8 IN755A
C4 1
R17 36.5K
CR4 IN965B
R18 1K
R16 100K
(14) MOTOR POWER T/M
(1) MOTOR POWER
(8) ANALOG T/M POWER
(21) ELECT POWER
(20) ELECT POWER T/M
(29) MOTOR HIGH POWER
(33) MOTOR LOW POWER
(36) MOTOR MODE T/M
(19) 28V RETURN
(30) PURGE VALVE T/M
(37) PURGE VALVE
LAST NOS USED
CR11 C4 R18
K5
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, 1%, 1/4 W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, 20%, 20 V.
REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
A
Q7 Q6 Q5 Q4 Q3 Q2 Q1
QUANTITY PER GROUP
ITEM NO.
SIZE
PART OR IDENTIFYING NO.
NOMENCLATURE OR DESCRIPTION
LIST OF MATERIALS OR PARTS LIST
MATERIAL
FINISH
8120793
61205
NEXT ASSEMBLY
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES
TOLERANCES
BASIC DIMENSION
DECIMALS
2 PLACE
3 PLACE
ANGLES
UNDER 6 ±.02 ±.010
6-24 INCL. ±.03 ±.020
OVER 24 ±.06 ±.030
±½°
DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE 39.101 APPLIES
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APPROVALS
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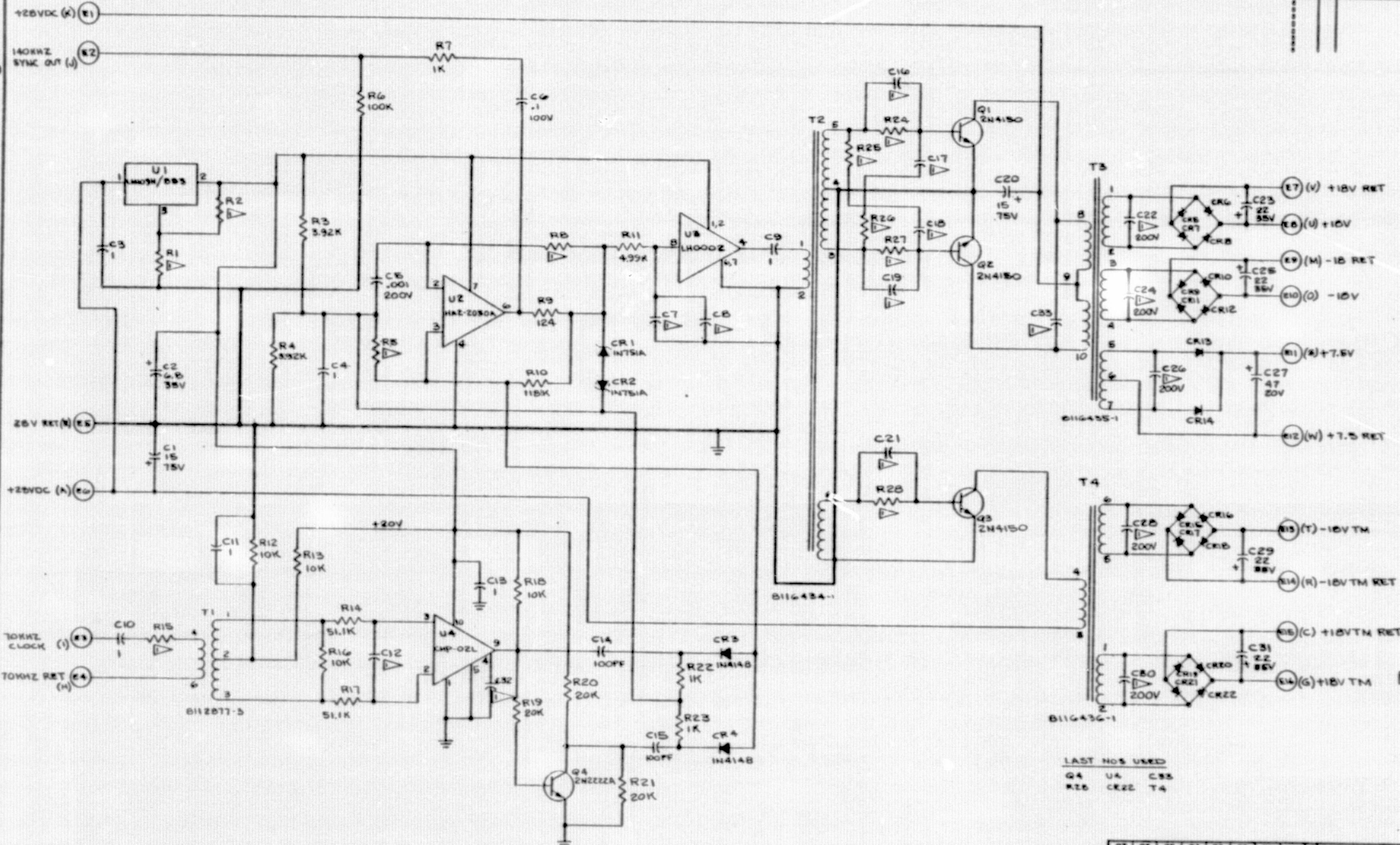
ENGR
OTHER
ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
DIAGRAM, SCHEMATIC - COMMAND RELAY #2
D
31550
8120791
SCALE NONE
SHEET



1 TAILOR POINT

UNLESS OTHERWISE SPECIFIED
ALL RESISTANCE VALUES ARE IN OHMS, 1% .1W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ±10% 50V
ALL DIODES HFR10 OR MB-1388

LAST NOS USED

Q4	U4	C33
R28	CR22	T4

TAILOR VALUES

MODEL	R1	R2	R5	R8	C7	C8	R15	C12	C16	C17	C18	C19	C21	R24	R25
FLIGHT MOD 1	1.65K	2.21K	14.3K	10K	68	22	JUMPER	100PF	OPEN	4700	4700	OPEN	OPEN	301 Ω	JUMPER

R26	R27	R28	C22	C24	C26	C28	C30	C32	C33
JUMPER	301 Ω	499 Ω	OPEN	OPEN	OPEN	OPEN	OPEN	1000PF	100PF

REVISIONS 61205-112

ZONE	LTR	DESCRIPTION	DATE	APPROVED

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

QUANTITY PER GROUP

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
8120778	61205

APPLICATION

MATERIAL

FINISH

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TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	±½°
6-24 INCL.	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE, 39.101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN [illegible] APR 16 1974
CHECKED
ENGR [illegible] 9-23-74
[illegible] 9-24-74
[illegible]
QTAO V.E. Smink 9/23/74
OTHER

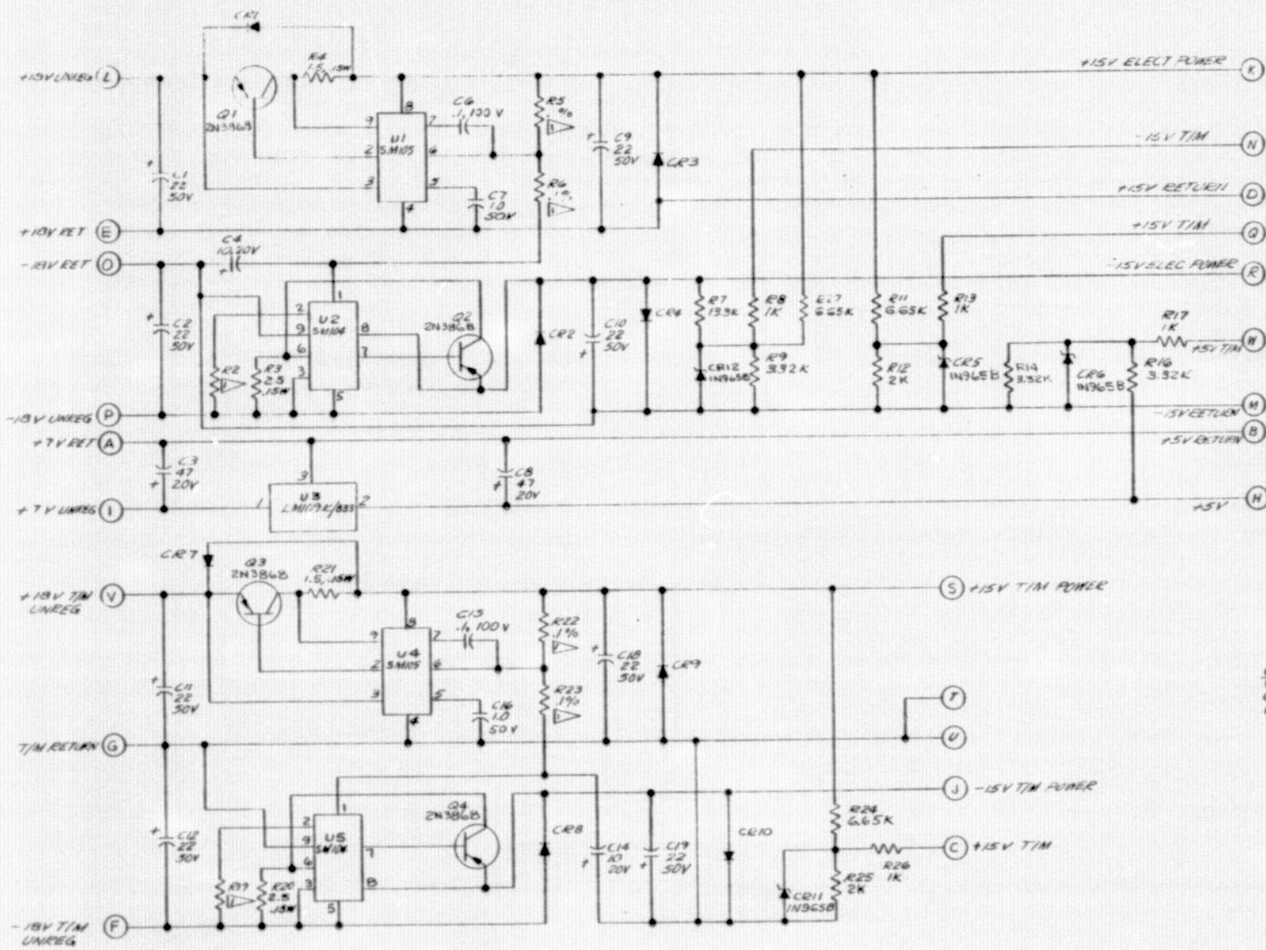
ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC, POWER CONVERTER

DWG SIZE D | CODE IDENT NO. 31550 | 8120776

SCALE | SHEET

8120776



LAST NOS USED

R27	REG5
CR12	Q4
C19	

NUMBERS NOT USED

R1 R15
R18 C13
R10

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, ± 5% ¼ W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ±10% 20V.
DIODES HFR10 OR MBT5415

TAILOR VALUES						
MODEL	R2	R5	R6	R19	R22	R23
FLIGHT MOD1	2.43K	13.2K	9.20K	2.43K	13.2K	9.20K

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

8120811	61205
NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	± .02	± .010	±½°
6-24 INCL.	± .03	± .020	
OVER 24	± .06	± .030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE, 39.101 APPLIES

CONTRACT NO. NAS 8-20621

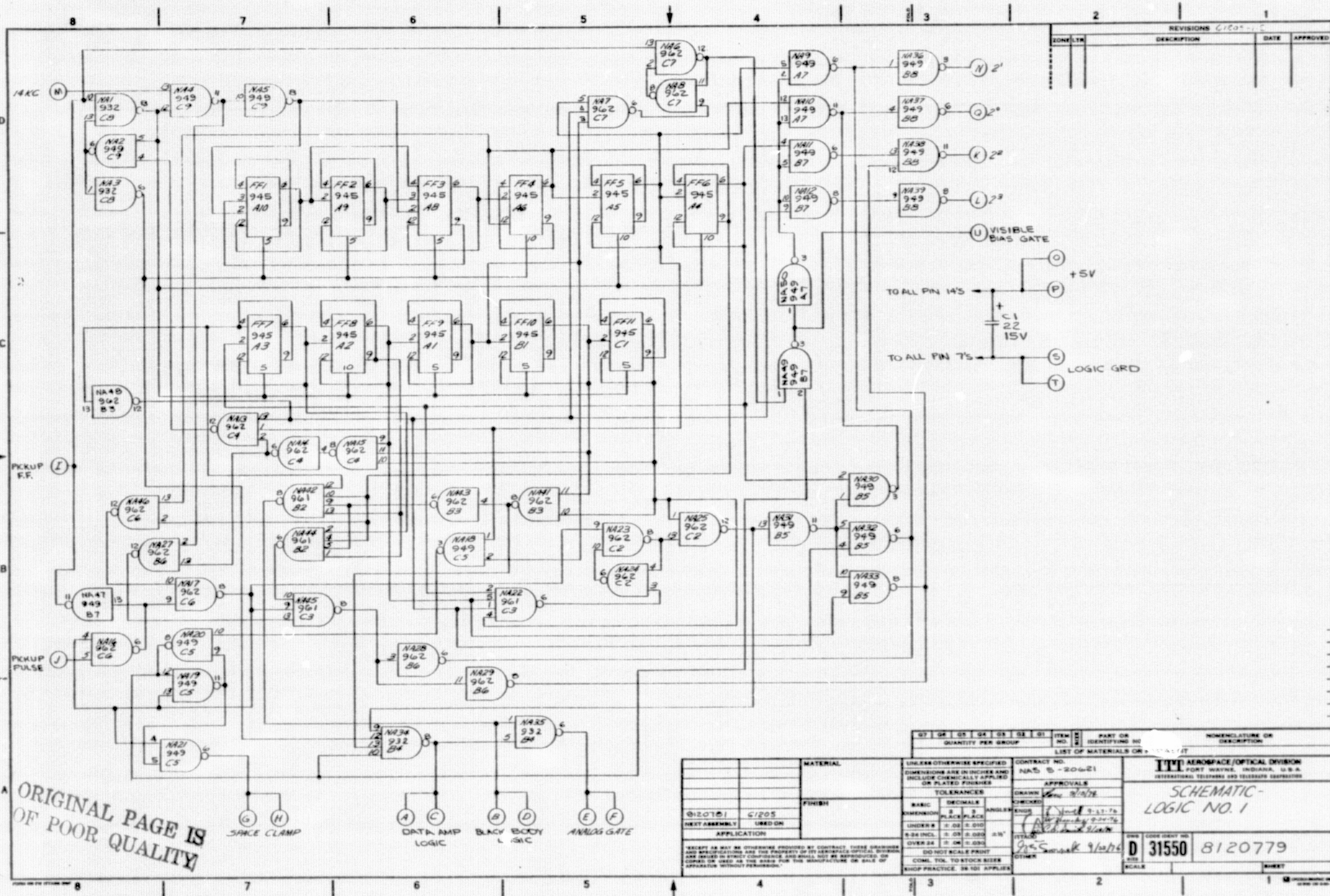
APPROVALS
DRAWN 9/13/72
CHECKED
ENGR. 9-22-72
ITTAOD 9/23/72
OTHER

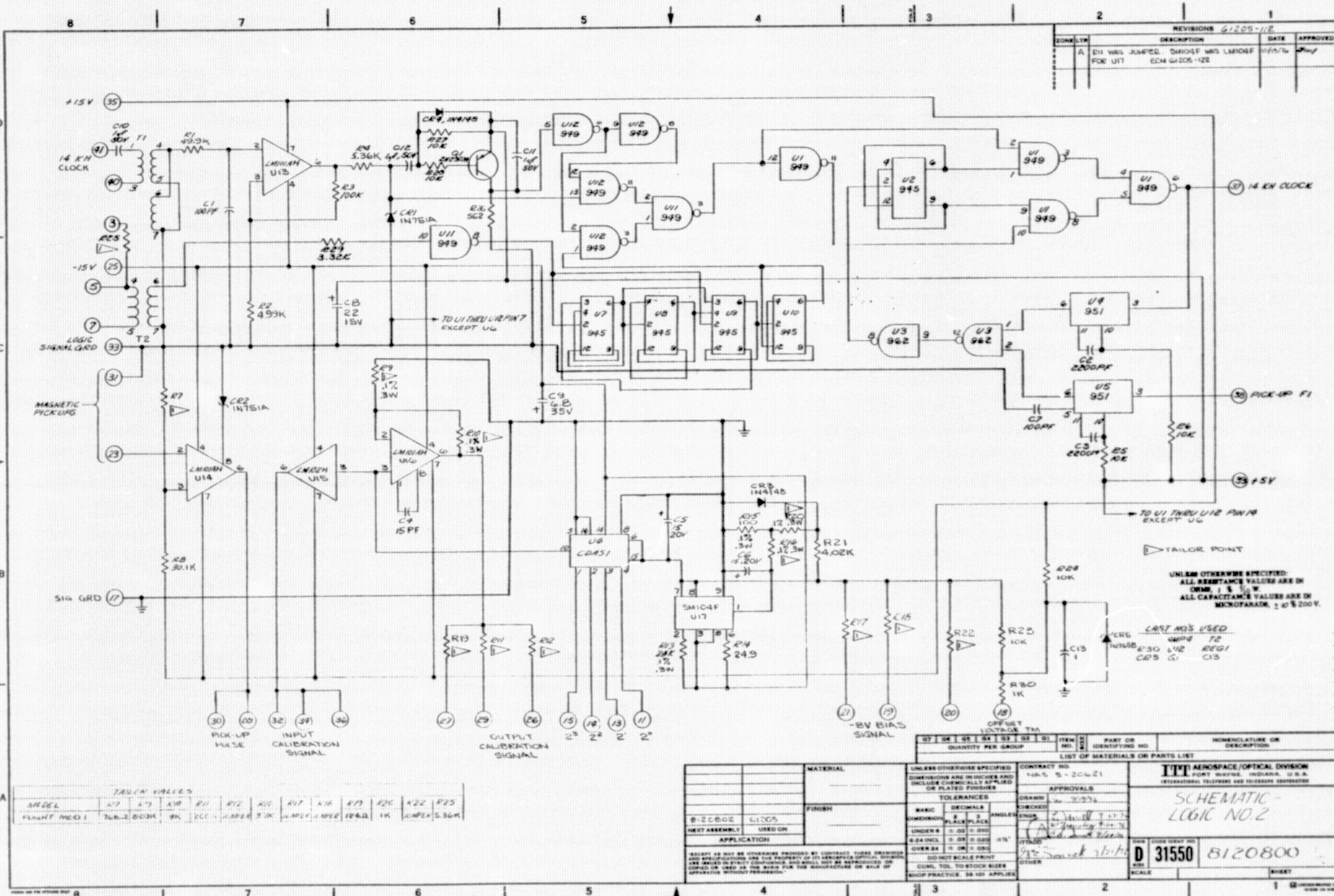
ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC - VOLTAGE REGULATORS

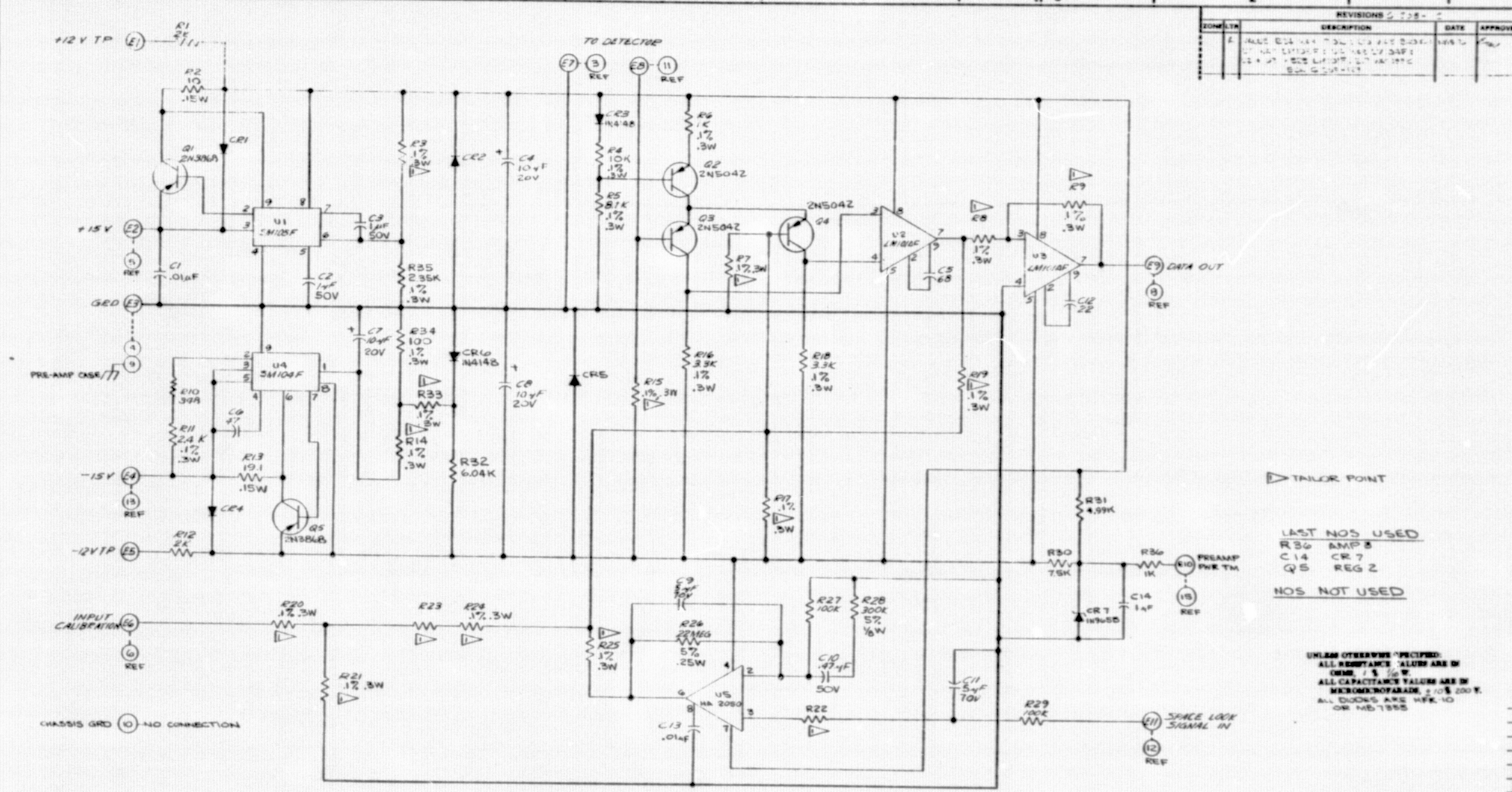
DWG SIZE D | CODE IDENT NO. 31550 | 8120809

SCALE | SHEET


14KC
PICKUP F.F.
PICKUP PULSE
VISIBLE BIAS GATE
TO ALL PIN 14'S
+5V
C1 22 15V
TO ALL PIN 7'S
LOGIC GRD
SPACE CLAMP
DATA AMP LOGIC
BLACK BODY LOGIC
ANALOG GATE
REVISIONS
LIST OF MATERIALS
NAS 5-20621
ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
SCHEMATIC - LOGIC NO. 1
D 31550 8120779
8120781 61205
NEXT ASSEMBLY
USED ON
APPLICATION
8120779



REVISIONS 61205-112
A R11 WAS JUMPER. SM104F WAS LM104F FOR U17 ECN 61205-122
+15V
14 KH CLOCK
-15V
LOGIC SIGNAL GRD
MAGNETIC PICKUPS
SIG GRD
TO U1 THRU U12 PIN 7 EXCEPT U6
TO U1 THRU U12 PIN 14 EXCEPT U6
PICK-UP F1
+5V
TAILOR POINT
UNLESS OTHERWISE SPECIFIED: ALL RESISTANCE VALUES ARE IN OHMS, ± 1% 1/8 W. ALL CAPACITANCE VALUES ARE IN MICROFARADS, ± 10% 200 V.
LAST NO'S USED
PICK-UP PULSE
INPUT CALIBRATION SIGNAL
OUTPUT CALIBRATION SIGNAL
-8V BIAS SIGNAL
OFFSET VOLTAGE TM
TAILOR VALUES
MODEL
FLIGHT MOD 1
LIST OF MATERIALS OR PARTS LIST
ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
CONTRACT NO. NAS 5-20621
SCHEMATIC - LOGIC NO. 2
D 31550 8120800



TAILOR VALUES															
MODEL	R3	R7	R8	R9	R14	R15	R17	R19	R20	R21	R23	R24	R25	R33	R22
FLIGHT MOD I	12.6K	30K	6.7K	10K	6.4K	2.4K	1.33K	10K	13.4K	20K	JUMPER	22K	2K	1.34K	1K

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.		PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

8120799	6/205
NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL

FINISH

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	± .03	± .010	±½°
6-24 INCL.	± .03	± .020	
OVER 24	± .06	± .030	

DO NOT SCALE PRINT
CONS. TOL. TO STOCK SIZES
SHOP PRACTICE 39.101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN 9/13/76
CHECKED
ENGR 9-23-76
9-24-76
9/23/76

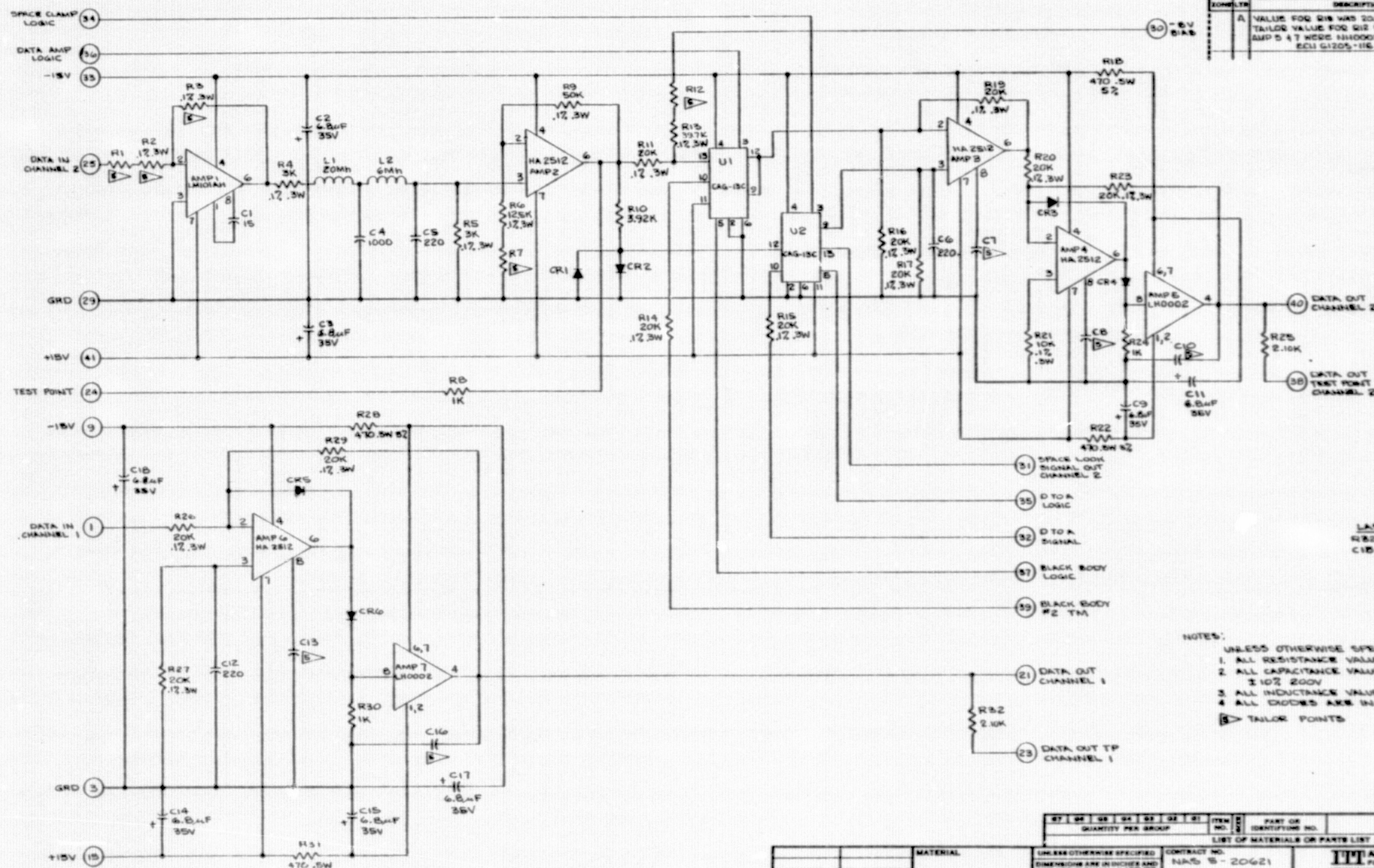
ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC – PRE AMP

SIZE	CODE IDENT NO.	
D	31550	8120797

SCALE — SHEET

REVISIONS 61205-115				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	VALUE FOR R18 WAS 20.0K TAILOR VALUE FOR R12 WAS 14.0K AMP 5 & 7 WERE NH0002 ECU 61205-116	10/4/76	



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS, 1%, 1/10W
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS. ±10% 200V
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES
4. ALL DIODES ARE IN4148

5 TAILOR POINTS

TAILOR VALUES										
MODEL	R1	R2	R3	R7	R12	C7	C8	C10	C16	C13
FLIGHT MODEL 1	JUMPER	6.98K	84K	15.0K	15.0K			1000	1000	

07	06	05	04	03	02	01	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
8120784	61205

APPLICATION

MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	±1/2°
6-24 INCL.	±.03	±.020	
OVER 24	±.04	±.030	

DO NOT SCALE PRINT

COML. TOL. TO STOCK SIZES

SHOP PRACTICE 38-101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS

DRAWN 11-7-75

CHECKED

ENGR.

ITT/AOD 9/23/76

OTHER

ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC - POST AMP

DWG SIZE	CODE IDENT NO.	
D	31550	8120782

SCALE — SHEET

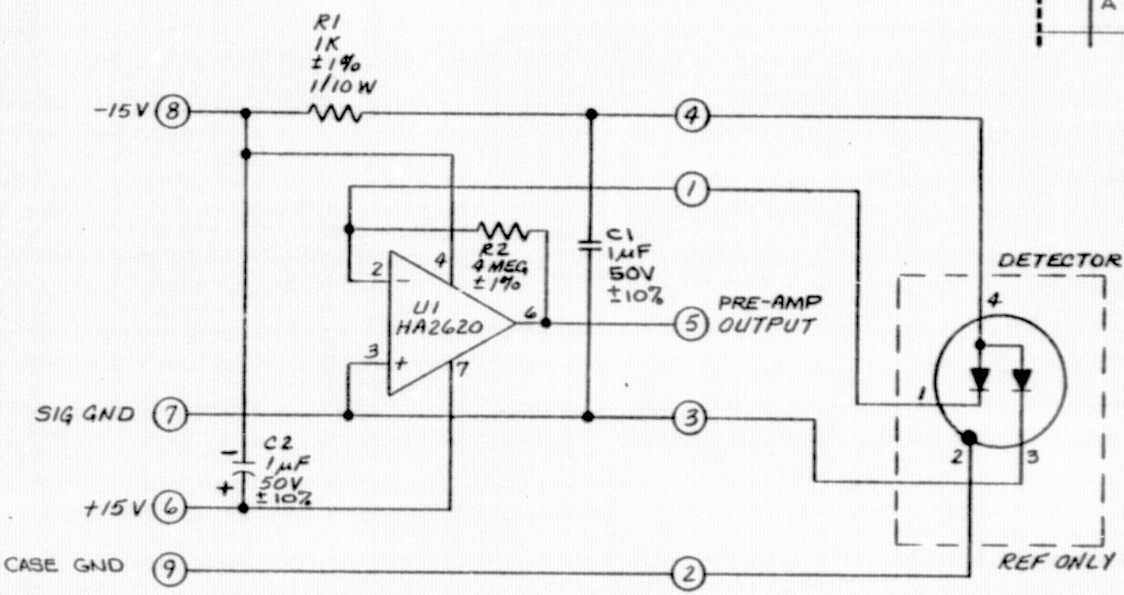
8120782 A

LINCOLN-GRAPHIC CORP.

8008130

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	"CASE GND" WAS "CH GND" ECN 61205-115	10/15/74	[illegible]

REVISIONS 61400-281



LAST NO'S USED
R2
C2
U1

G7	G6	G5	G4	G3	G2	G1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
	HCMR
8008132	AVHRR

APPLICATION

MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

2 PLACE DECIMALS ±.02
3 PLACE DECIMALS ±.010
ANGLES ±½°

COML. TOL. TO STOCK SIZES

SHOP PRACTICE, 39.101 APPLIES

CONTRACT NO. NAS 5-21900

APPROVALS

DRAWN	J. Douglas 1-21-75
CHECKED	
ENGR	[illegible] 1-22-75
ITTAOD	[illegible] 1-23-75
	[illegible] 1-23-75
OTHER	C.D. [illegible]

ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

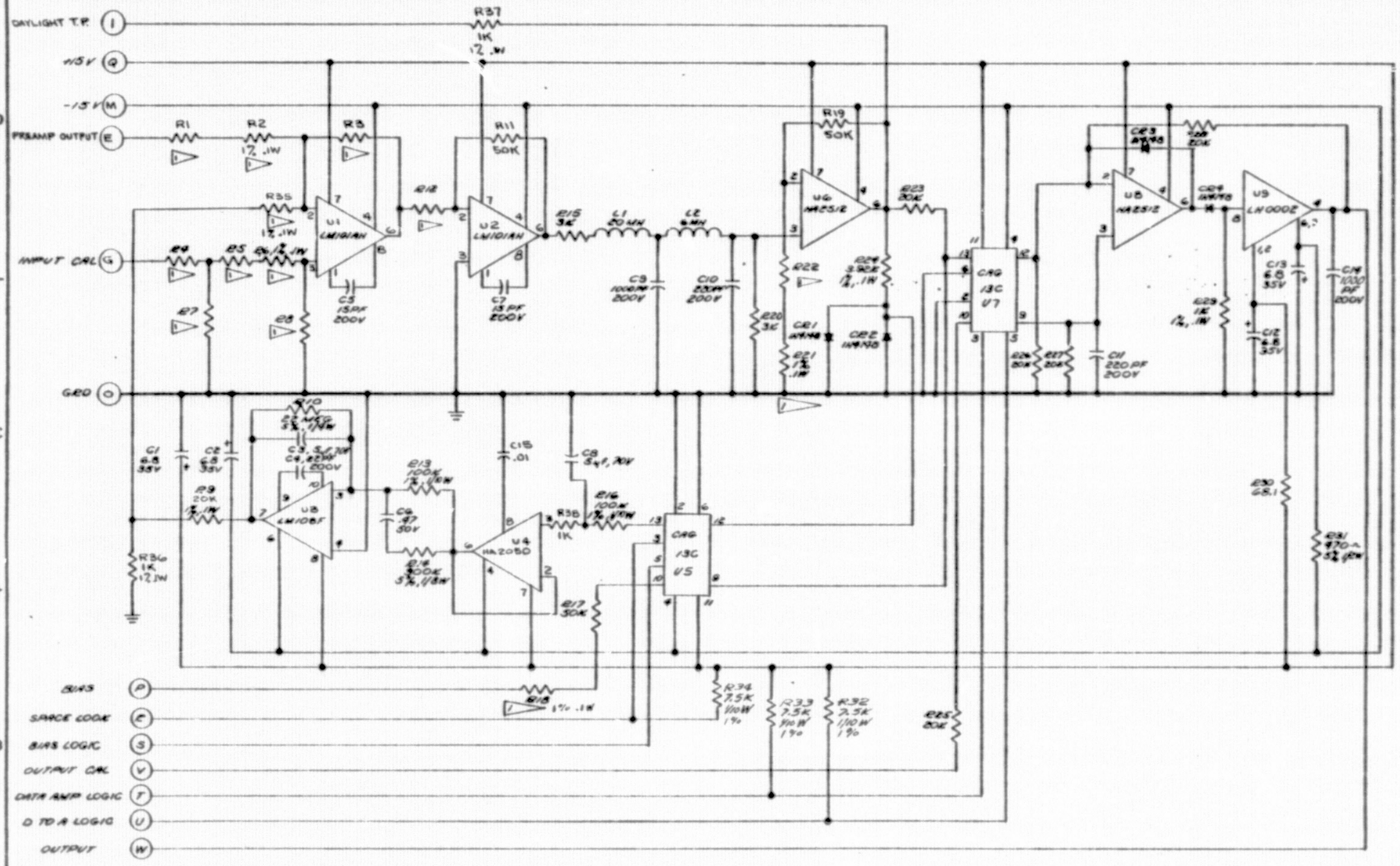
SCHEMATIC
DAYLIGHT PREAMP

SIZE	CODE IDENT NO.	
B	31550	8008130

SCALE ~ SHEET

FORM NO. FW ITT AOD D184

REVISIONS 61205-112				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	VALUE R5 WAS 140K; U9 WAS LH0002; VALUE R12 WAS 324K; R6 WAS 499 Ω. ECN 61205-124	[illegible]	[illegible]



TAILOR POINT

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, 1% 1/8 W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ± 10% 50 V

LAST NO'S. USED
R38 AMP7 U2 C15 CR4

TAILOR VALUES													
MODEL	R1	R2	R3	R4	R5	R6	R7	R8	R12	R18	R21	R22	R35
FLIGHT MOD 1	14.6K	24.9	13.4K	7.5K	17.0K	2K	8.1K	20K	36K	249	JUMPER	12.5K	20K

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

QUANTITY PER GROUP

LIST OF MATERIALS OR PARTS LIST

8120806	[illegible]
NEXT ASSEMBLY	USED ON

APPLICATION

MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES			
BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	± .02	± .010	±½°
6-24 INCL.	± .03	± .020	
OVER 24	± .06	± .030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE 39 101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN [illegible] 9-1-76
CHECKED
ENGR [illegible] 9-13-76
OTHER

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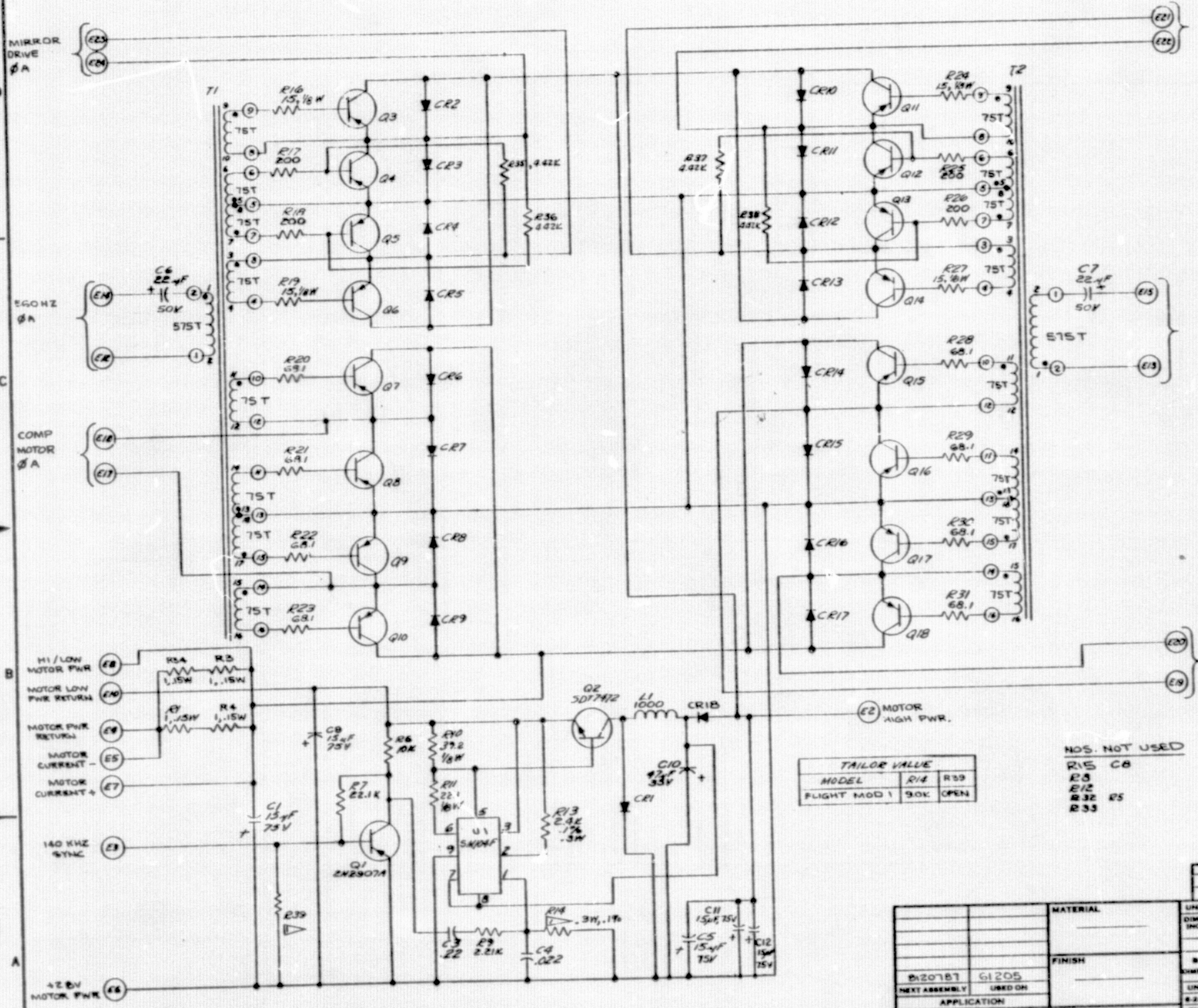
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC - VISIBLE CHANNEL

DWG SIZE D | CODE IDENT NO. 31550 | 8120806

SCALE NONE | SHEET

8120806 A



REVISIONS 61205-42				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	VALUE FOR C35 36, 37 & 38 WAS 1K; R14 WAS 8.2K. R20, 21, 22 26, 28, 29, 30 & 31 WERE 68 Ω. ECN 61205-120		

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, ±1% 1/10W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ±10% 100V.
ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

ALL TRANSISTORS ARE 2N5153
ALL DIODES ARE MB7386 CR HFR-10

TAILOR VALUE		
MODEL	R14	R39
FLIGHT MOD 1	9.0K	OPEN

NOS. NOT USED

R15 C8
R8
R12
R32 R5
R33

LAST NOS USED

R39 REG 1
C12 Q18
CR18 T2
L1 E25

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
8120787	61205

APPLICATION

MATERIAL

FINISH

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES			
BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	±½°
6-24 INCL.	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE. 39.101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN 9/13/76
CHECKED
ENGR. 9-23-76
9-24-76
9/24/76
9/23/76
OTHER

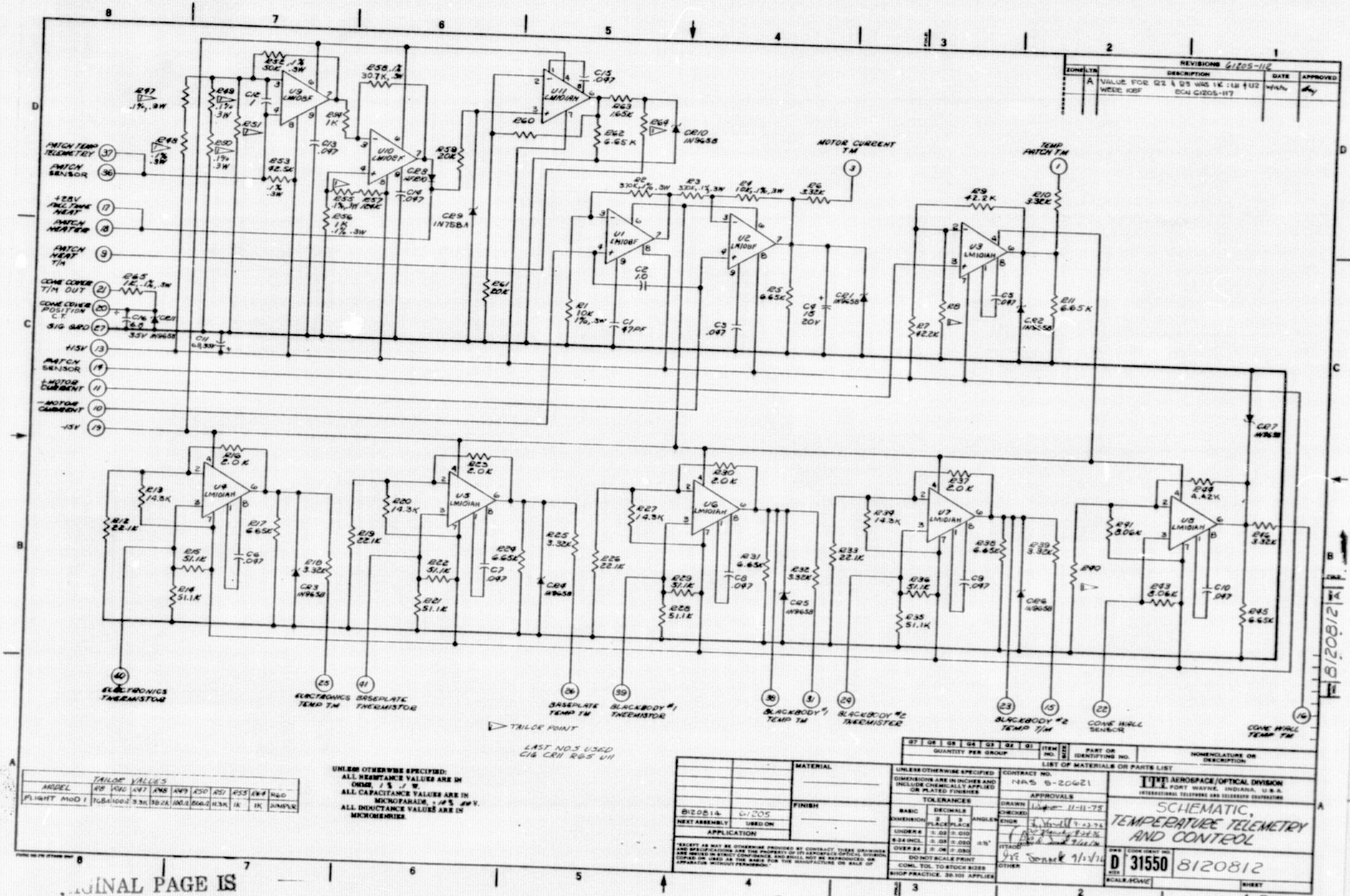
ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC – MOTOR POWER SUPPLY

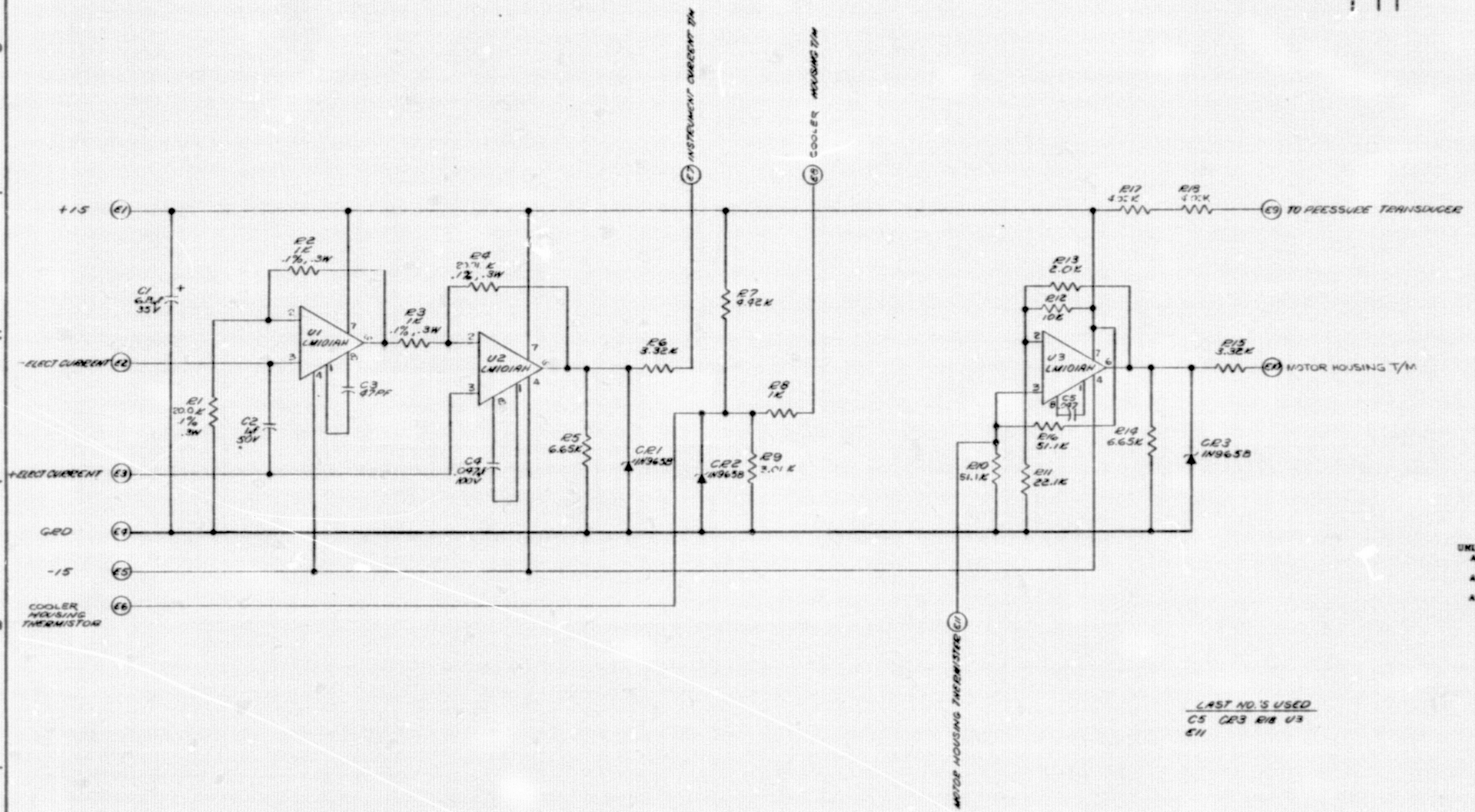
DWG SIZE D | CODE IDENT NO 31550 | 8120785
SCALE ~ | SHEET

3-31

ORIGINAL PAGE IS OF POOR QUALITY



REVISIONS 61205-112
A VALUE FOR R2 & R3 WAS 1K; U1 & U2 WERE 108F ECN 61205-117
PATCH TEMP TELEMETRY
PATCH SENSOR
+28V FAILSAFE HEAT
PATCH HEATER
PATCH HEAT T/M
CONE COVER T/M OUT
CONE COVER POSITION C.T.
SIG GRD
+15V
PATCH SENSOR
+MOTOR CURRENT
-MOTOR CURRENT
-15V
MOTOR CURRENT TM
TEMP PATCH TM
ELECTRONICS THERMISTOR
ELECTRONICS TEMP TM
BASEPLATE THERMISTOR
BASEPLATE TEMP TM
BLACKBODY #1 THERMISTOR
BLACKBODY #1 TEMP TM
BLACKBODY #2 THERMISTER
BLACKBODY #2 TEMP T/M
CONE WALL SENSOR
CONE WALL TEMP TM
TAILOR POINT
LAST NO.S USED C16 CR11 R65 U11
TAILOR VALUES
MODEL
FLIGHT MOD 1
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, 1%, 1/4 W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS, ±10%, 50V.
ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
8120814 61205
NEXT ASSEMBLY USED ON
APPLICATION
MATERIAL
FINISH
CONTRACT NO. NAS 5-20621
LIST OF MATERIALS OR PARTS LIST
ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
SCHEMATIC, TEMPERATURE TELEMETRY AND CONTROL
D 31550 8120812
8120812 A



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, 1 % .10 W.
ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS, ± 10 % 200 V.
ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

LAST NO.'S USED
C5 CR3 R18 U3
E11

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

8120805	61205
NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL

FINISH

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DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	±½°
6-24 INCL.	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE 39.101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN 9/1/74
CHECKED
ENGR 9-23-76
9-24-76
9/24/76
ITTAOD 9/22/76
OTHER

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
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SCHEMATIC, TELEMETRY NO. 2

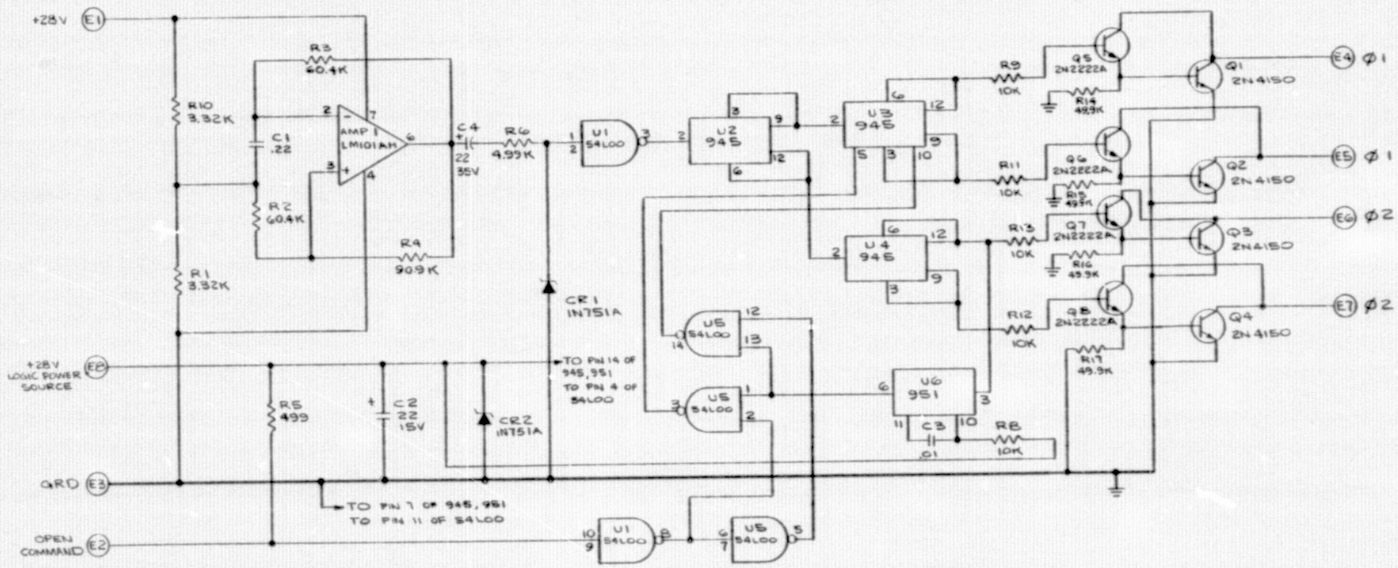
DWG SIZE D | CODE IDENT NO. 31550 | 8120803

SCALE NONE | SHEET

3-33

REVISIONS 61205-112

ZONE	LTR	DESCRIPTION	DATE	APPROVED



NO'S. NOT USED
R7

LAST NO'S. USED
R17 C4 CR2 E8
U6 AMP1 Q8

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, ± % W.
ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS, ± % V.

G7	G6	G5	G4	G3	G2	G1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										
LIST OF MATERIALS OR PARTS LIST										

NEXT ASSEMBLY	USED ON
8120790	61205
APPLICATION	

MATERIAL

FINISH

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	2 PLACE	3 PLACE	ANGLES
UNDER 6	±.02	±.010	±½°
6-24 INCL.	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE 30.101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS
DRAWN 9/19/76
CHECKED
ENGR 9-23-76
9-24-76
9/24/76
STAND 9/23/76
OTHER

ITT AEROSPACE/OPTICAL DIVISION FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC-AMPL CONE COVER

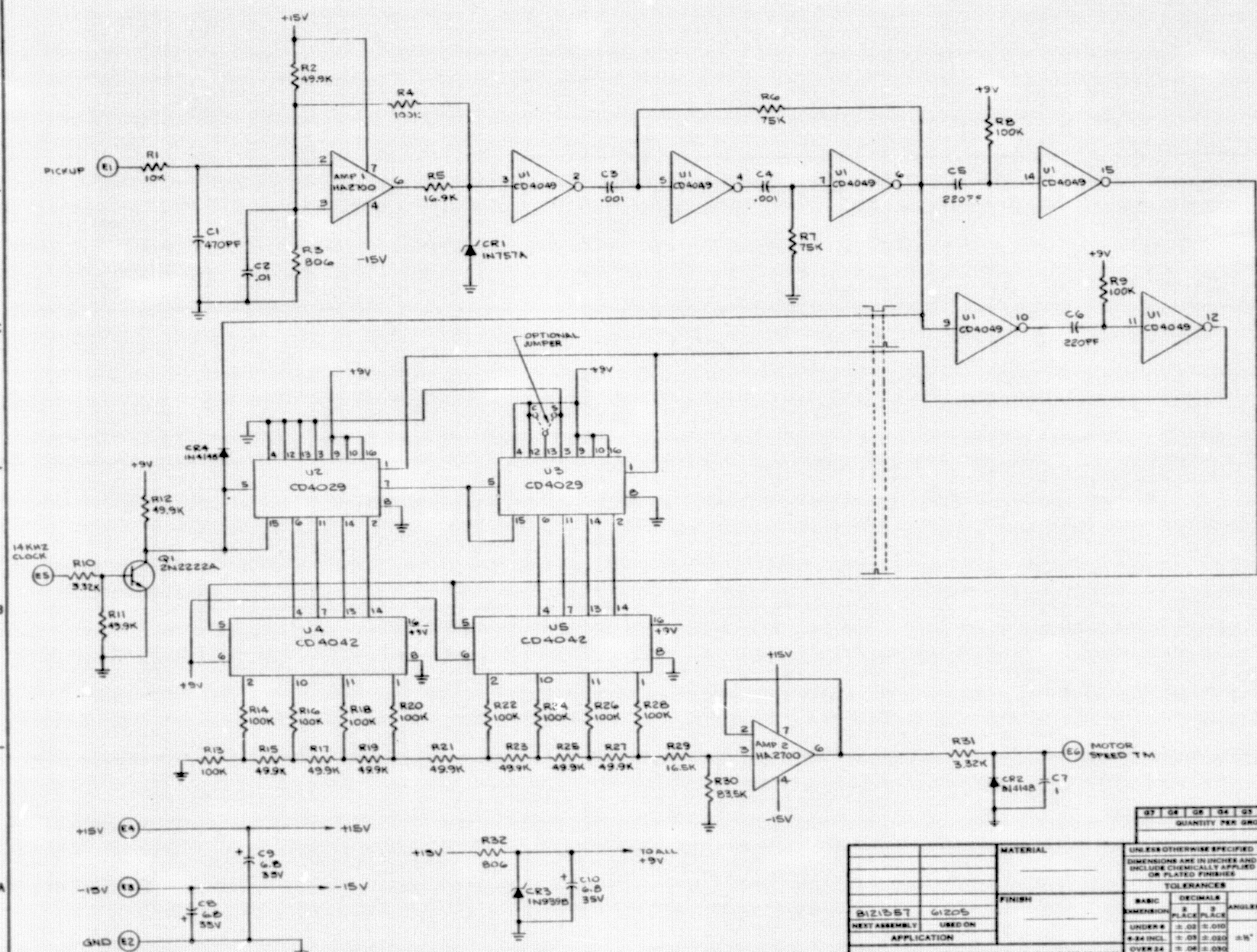
DWG SIZE D | CODE IDENT NO 31550 | 8120788

SCALE | SHEET

8120788

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	24 WAS 22.6K ; CR2 WAS 1N965 ECN G1205-119	10/6/76	

REVISIONS G1205-112



LAST NOS USED

AMP 2	C10	U5
R31	CR4	

NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1% 1/10W
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS ±10% 200V
3. CD4049 PIN 1 = +10V
   PIN 8 = GND

Q7	Q6	Q5	Q4	Q3	Q2	Q1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
8121357	61205

APPLICATION

MATERIAL

FINISH

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	±½°
6-24 INCL	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT
COML. TOL. TO STOCK SIZES
SHOP PRACTICE, 39-101 APPLIES

CONTRACT NO. NAS 5-20621

APPROVALS

DRAWN 11-11-75
CHECKED
ENGR 9-23-76
8-24-76
9/23/76
9/23/76
OTHER

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INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SCHEMATIC - MOTOR SPEED TM

DWG SIZE	CODE IDENT NO.	
D	31550	8121355

SCALE SHEET

8121355 A

B-35

4.0 HCMR COMMANDS

The commands associated with the HCMR experiment are:

HCMR Motor On
HCMR Motor Off
HCMR Electronics On
HCMR Electronics Off
HCMR Motor High Pwr Mode
HCMR Motor Low Pwr Mode
HCMR Patch Heater Full Time
HCMR Patch Heater Automatic
HCMR Cone Heater On
HCMR Cone Heater Off
HCMR Cone Cover Close #1
HCMR Cone Cover Deploy #1
HCMR Purge Valve Open
HCMR Purge Valve Close
HCMR Cone Cover Close #2
HCMR Cone Cover Deploy #2
HCMR Pickup #1 On
HCMR Pickup #2 On
HCMR Purge Valve Open
HCMR Purge Valve Close

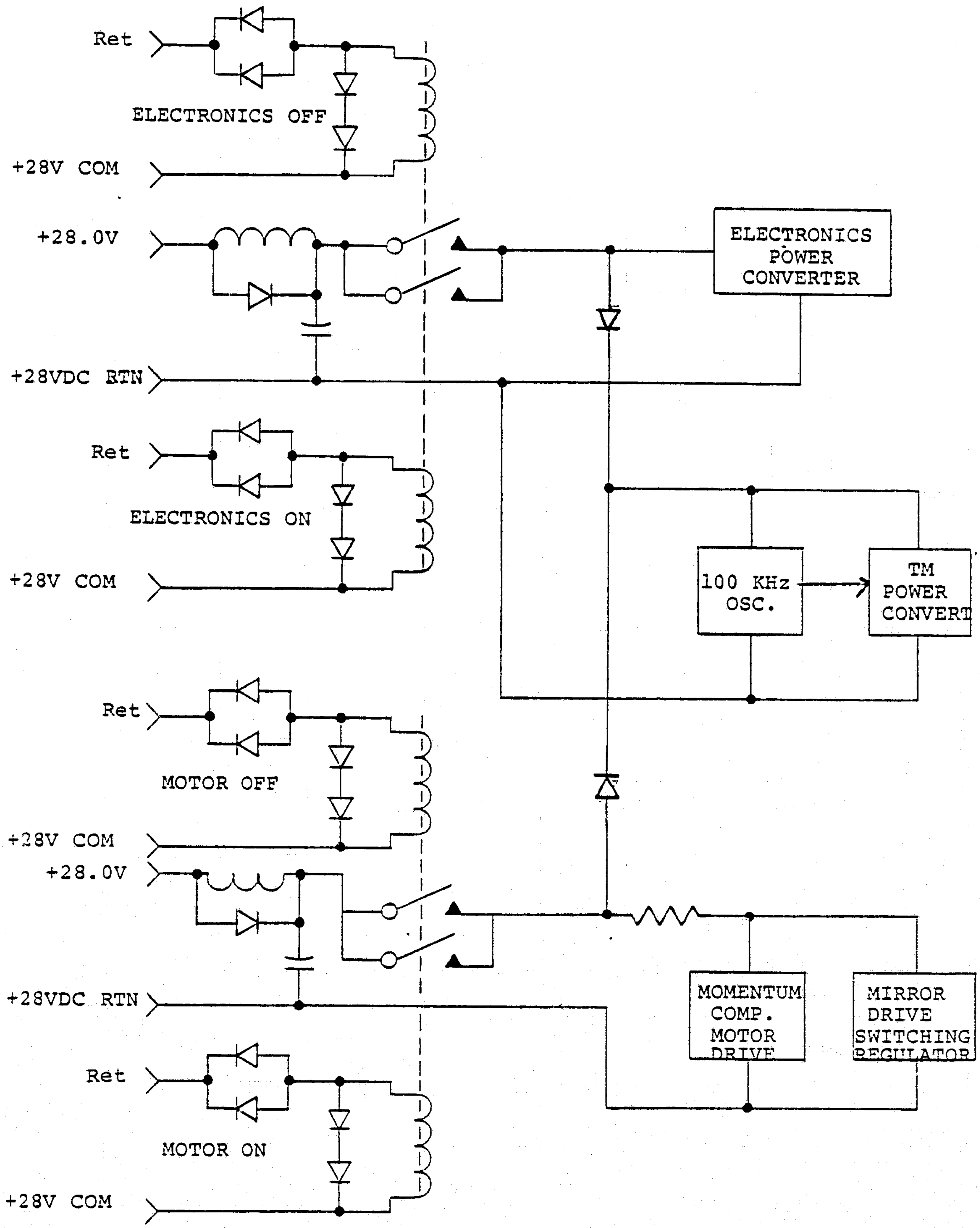
4.1 Command Descriptions

4.1.1 HCMR Motor On/Off

Execution of the HCMR Motor On command connects the regulated buss voltage to the motor power supply, the 140 KHz oscillator, and the telemetry power converter. As a result the scan mirror rotates and all temperature telemetry is activated. Execution of the HCMR Motor Off command removes the regulated buss voltage from the motor power supply, the 140KHz oscillator, and the telemetry power converter. (See HCMR Electronics On/Off and Motor On/Off Command relay schematic.)

4.1.2 HCMR Electronics On/Off

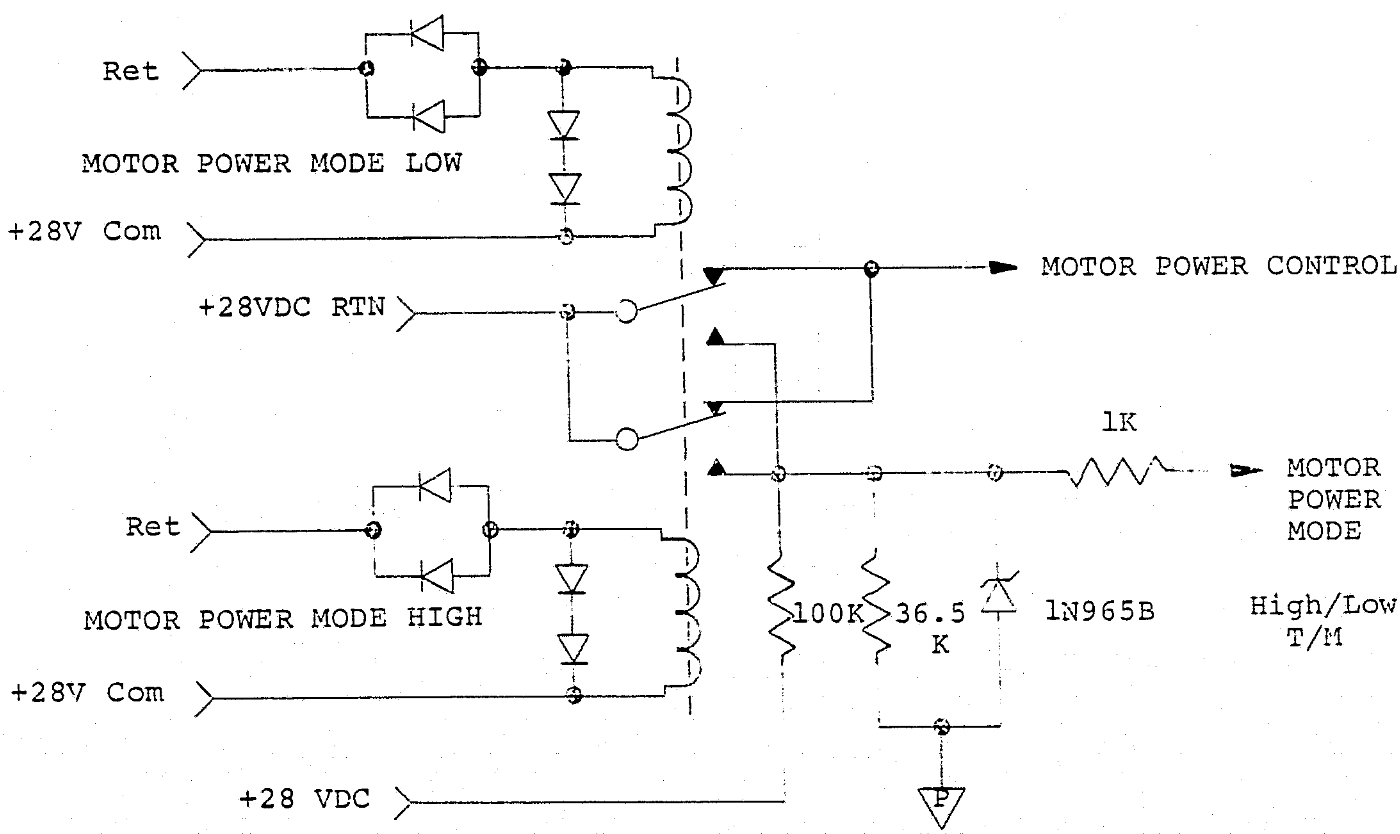
Execution of the HCMR Electronics On command connects the regulated buss voltage to the telemetry power supply, the 140 Hz oscillator and the DC to DC converter. All HCMR circuitry with the exception of the motor power supply is energized upon execution of this command. Execution of the HCMR Electronics off command removes all power from the HCMR with the exception of those functions powered by the motor on/off command. (See HCMR Electronics On/Off and Motor On/Off Command Schematic.)



ELECTRONICS ON/OFF AND MOTOR ON/OFF COMMAND RELAY SCHEMATIC

4.1.3 HCMR Motor Power Mode High/Low

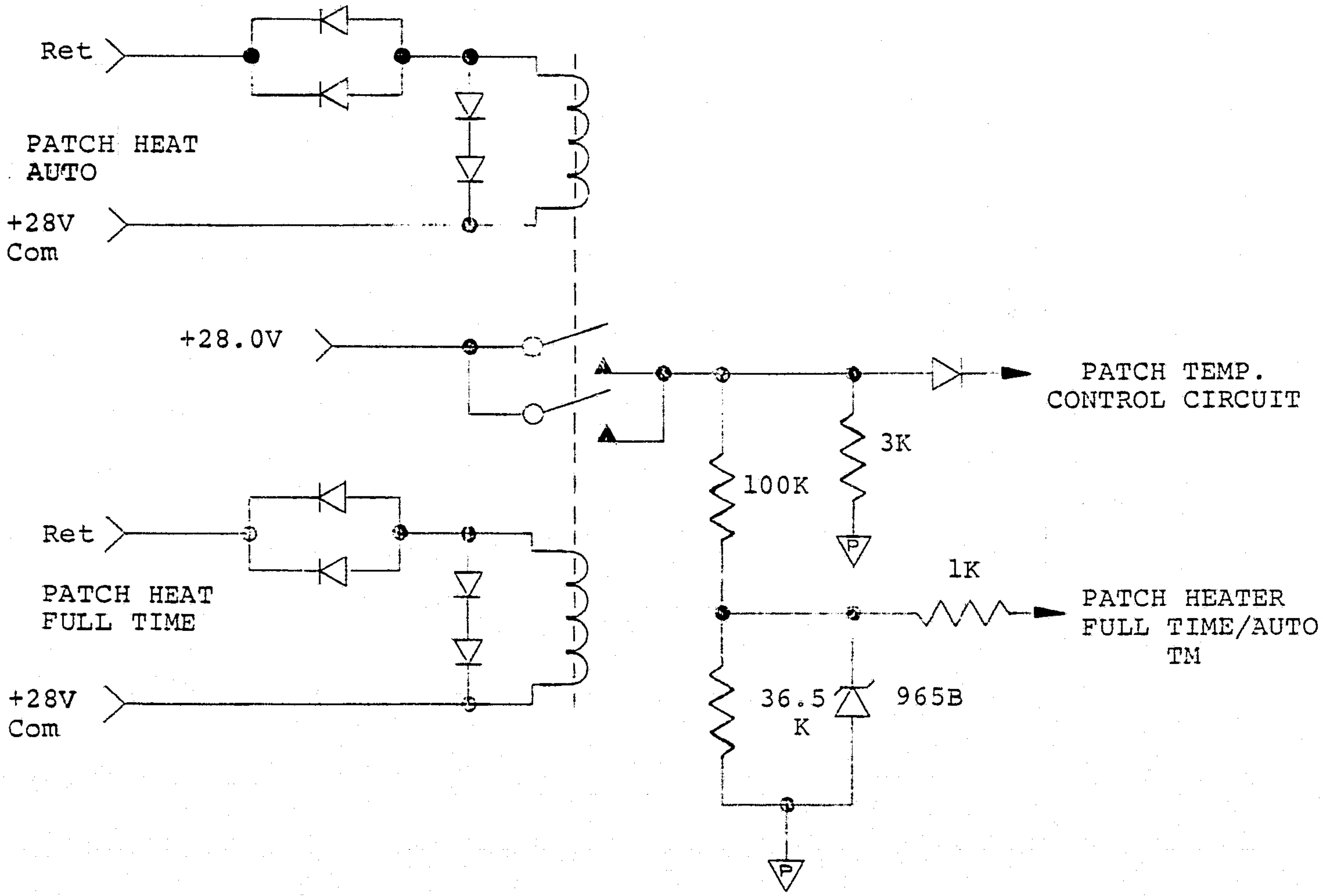
Execution of the HCMR Motor Power Mode High command applies +28V directly to the motor power supply. In this mode the scan motor delivers 7.0 in. oz. torque. The high power mode is required for in air operation of the scan mirror. Execution of the HCMR Motor Power Low command applies the +28V to a switching regulator. The switching regulator output is applied to the motor power supply. In this mode the scan supplies 2.0 in.oz. torque. The Low Power Mode is utilized for in vacuum operation of the motor. (See HCMR Motor Power Mode High/Low Command Schematic.)



HCMR MOTOR POWER HIGH/LOW COMMAND SCHEMATIC

4.1.4 HCMR Patch Heater Full Time/Automatic

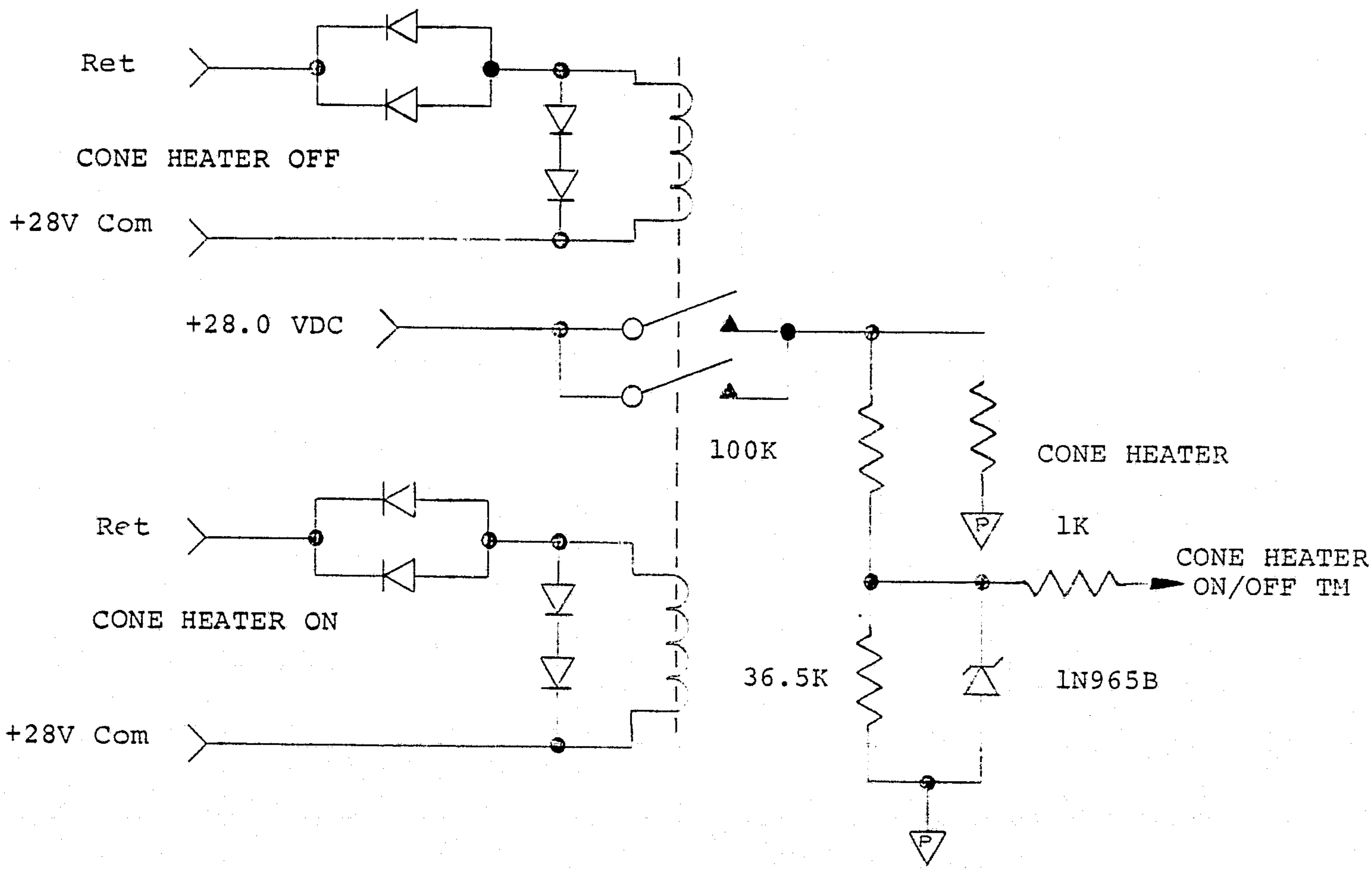
Execution of the HCMR Patch Heater Full Time command applies +28.0 volts directly to the patch heating element. Execution of the HCMR Patch Heater Automatic Command removes +28.0 volts from the patch heater allowing the automatic control circuit to regulate the patch temperature. (See HCMR Patch Heater Full Time/Automatic Command Schematic).



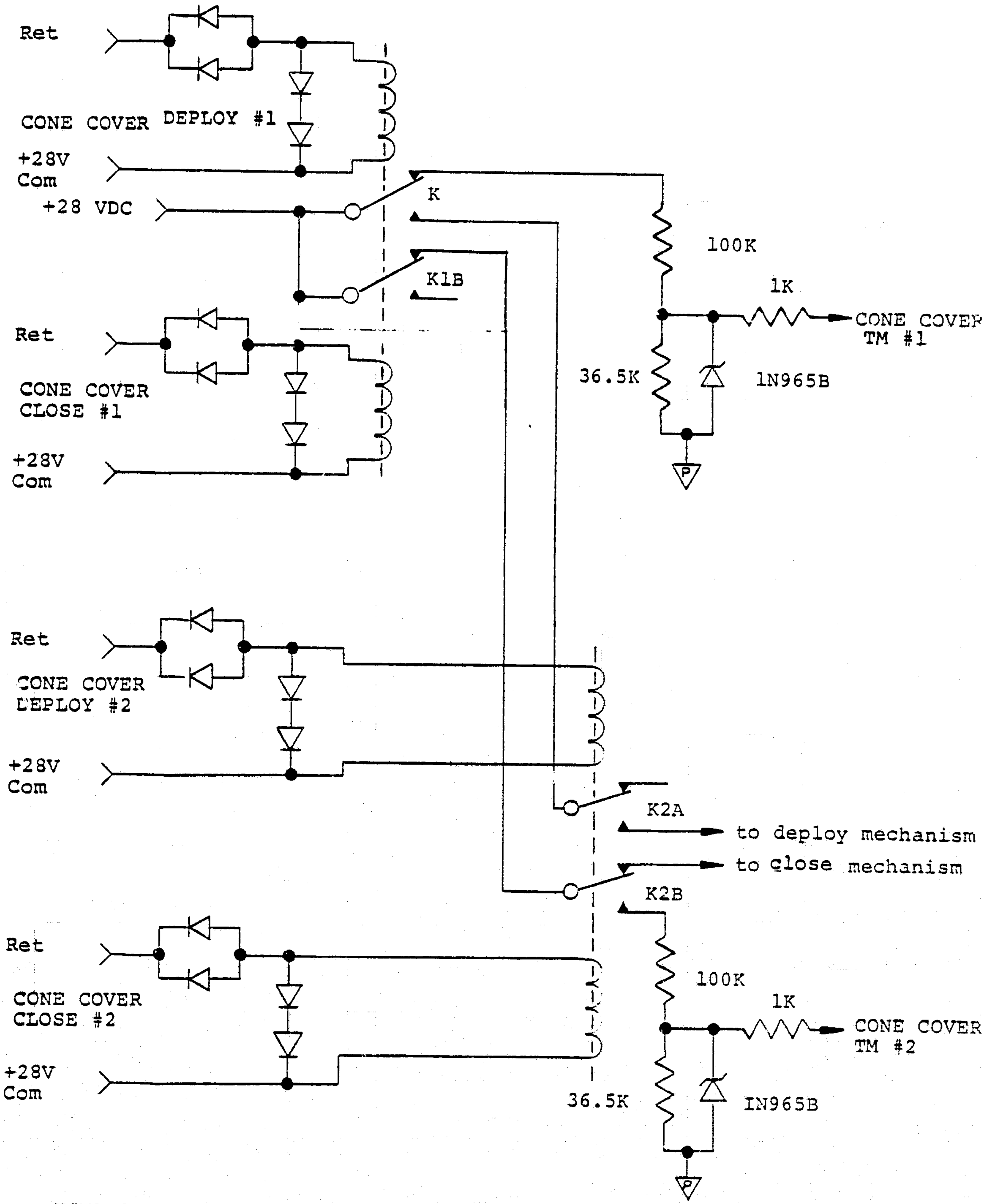
HCMR PATCH HEATER FULL TIME/AUTOMATIC COMMAND SCHEMATIC

4.1.5 HCMR Cone Heater ON/Off

Execution of the HCMR Cone Heater On command applies regulated buss voltage to the cone heaters causing the cooler cone wall temperature to increase. Execution of the HCMR Cone Heater Off Command removes regulated buss voltage from the cone heaters. (See HCMR Cone Heater On/Off Command Schematic).



CONE HEATER ON/OFF COMMAND RELAY SCHEMATIC



HCMR CONE COVER DEPLOY #1 AND 2 AND CONE COVER CLOSE #1 AND 2
COMMAND RELAY SCHEMATIC

4.1.6 HCMR Cone Cover Deploy No. 1 and No. 2

Both the cone cover deploy commands (No. 1 and No. 2) must be given to deploy the cone door. Execution of both the Cone Cover deploy commands actuates the deployment mechanism.

4.1.7 HCMR Cone Cover Close No. 1 and No. 2

Both the cone cover close commands (No. 1 and No. 2) must be given to close the cone door. Execution of both the HCMR Cone Cover close commands causes the earth albedo shield to be stored as a cone cover.

4.1.8 HCMR Purge Valve Open/Close

Execution of the HCMR Vent Valve Open command causes the purge value to open allowing dry nitrogen from the on board supply to flow into the detector anti-frost enclosures (AFE). Execution of the Purge Valve Close command removes power from the Purge Valve stopping the flow of on board gas to the anti-frost enclosure. The on board gas supply is utilized to provide a purge during the final phases of count down and Launch. (See the Purge Valve Open/Close Command Relay Schematic.)

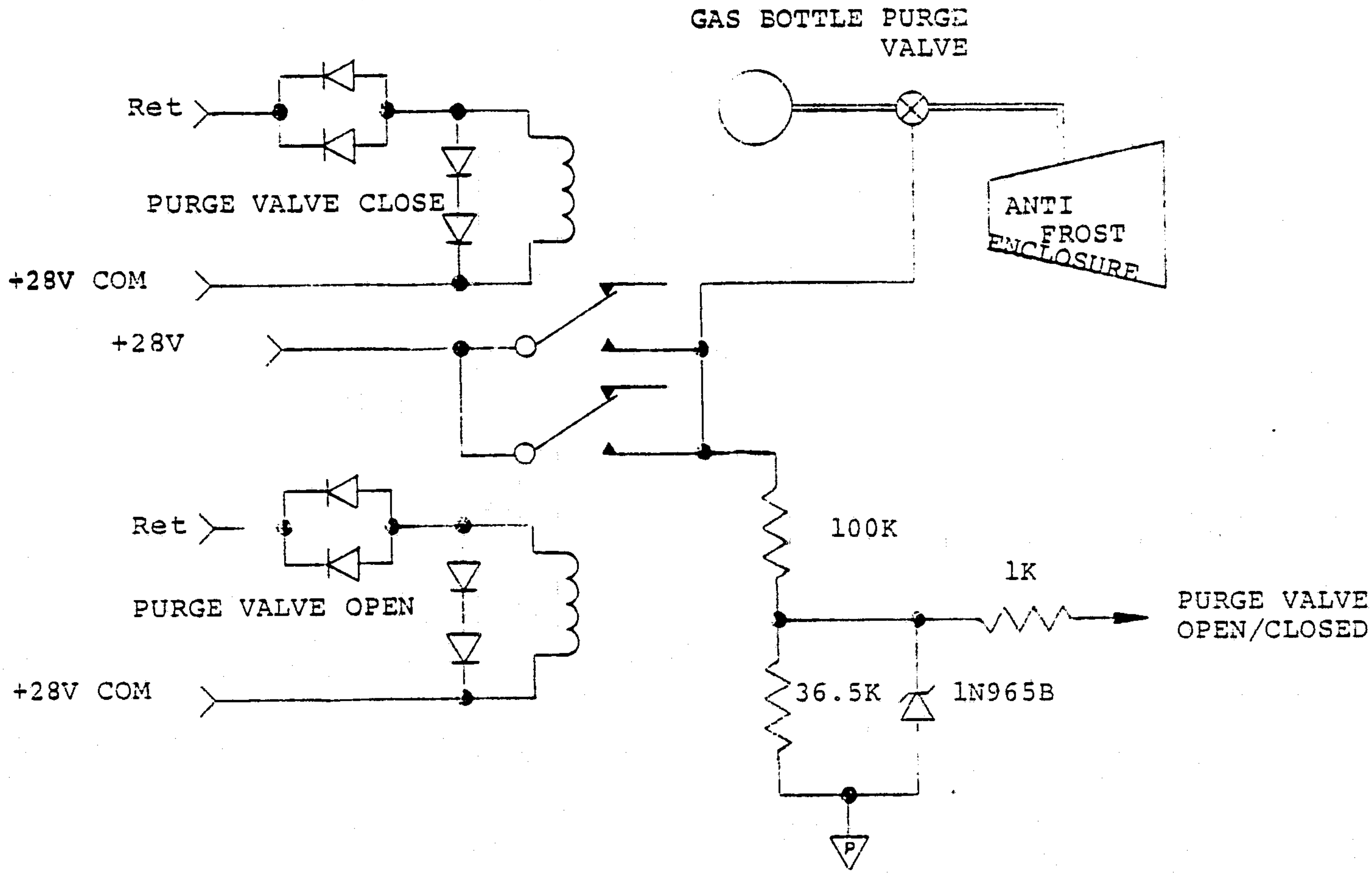
4.1.9 HCMR Pickup No. 1 to Pickup No. 2

Activation of HCMR Pickup No. 1 command allows this pickup output signal to be used for scan timing.

Activation of Pickup No. 2 command allows this pickup output signal to be used for scan timing.

4.2 Command Verification

Table 4-1 lists the commands associated with the HCMR experiment including a brief functional description of each command and telemetry verification of each command.



PURGE VALVE OPEN/CLOSED COMMAND RELAY SCHEMATIC

TABLE 4-1 HCMR COMMAND DESCRIPTION

COMMAND NUMBER	COMMAND NAME	COMMAND FUNCTION	TELEMETRY VERIFICATION
	HCMR Motor On	Applies +28.0 volts to scan mirror motor and power to temperature telemetry monitors.	1) HCMR motor On/Off T/M becomes a logical "1." 2) Most analog temperature telemetry assumes non-zero values. 3) Telemetry Power Monitor assumes a non-zero value.
	HCMR Motor Off	Removes +28.0 volts from scan mirror power supply and temperature monitors.	1) HCMR motor On/Off T/M becomes logical "0" 2) Temperature Telemetry monitors assume off values if Electronic On/Off TM is a logical "0."
	HCMR Electronics On	Applies +28.0 volts to all power converters except motor drive supply.	1) HCMR Electronics On/Off is a logical "1." 2) Most analog telemetry assume "On" values.
	HCMR Electronics Off	Removes +28.0 volts from all converters if motor is off.	1) HCMR Electronics On/Off is logical "0." 2) All telemetry assume off values proving motor On/Off TM is a logical "0."
	HCMR Motor Power Mode High	Changes voltage of motor power supply to High Power Mode.	HCMR Motor Power Mode High/Low TM is a logical "1."
	HCMR Motor Power Motor Low	Changes voltage of motor power supply to Low Pwr Mode,	HCMR Motor Power High/Low TM is a logical "0."

TABLE 4-1 HCMR COMMAND DESCRIPTION (Cont'd)

COMMAND NUMBER	COMMAND NAME	COMMAND FUNCTION	TELEMETRY VERIFICATION
	HCMR Patch Heater Full Time	Applies +28.0 volts to patch heater.	HCMR Patch Heater Full Time/Automatic TM is a logical "1".
	HCMR Patch Heater Automatic	Removes +28 volts from patch heater allowing automatic control.	HCMR Patch Heater Full Time/Automatic TM is a logical "0".
	HCMR Cone Heater On	Removes +28 volts to cone heater.	HCMR Cone Heater On/Off TM is a logical "1".
	HCMR Cone Heater Off	Removes +28.5 volts from cone heater.	HCMR Cone Heater On/Off TM is a logical "0".
	HCMR Cone Cover Close #1	In concert with Cone Cover Close #2.Causes Cone Cover to move to the position covering the radiant cooler.	1) HCMR Cone Cover TM #1 is a logical "1". 2) Cone cover position TM indicates stored position.
	HCMR Cone Cover Deploy #1	In concert with Cone Cover Deploy #2. Causes cone cover to deploy as an earth albedo shield.	1). HCMR Cone Cover TM #1 is a logical "0". 2) Cone Cover Position monitor indicates deployed position.
	HCMR Purge Valve Open	Activates Purge Valve to open position.	HCMR Purge Valve Open/Close TM is a logical "1".
	HCMR Purge Valve Close	Activate Purge Valve to Closed position.	HCMR Purge Valve Opened/Closed TM is a logical "0".

TABLE 4-1 HCMR COMMAND DESCRIPTION (Cont'd)

COMMAND NUMBER	COMMAND NAME	COMMAND FUNCTION	TELEMETRY VERIFICATION
	HCMR Cone Cover Close #2	In concert with Cone Cover Close #1. Causes Cone Cover to deploy as an earth albedo shield.	HCMR Cone Cover Enable Deploy/Store is a logical "1".
	HCMR Cone Cover Deploy #2	In concert with Cone Cover #1. Causes Cone Cover to move to the position covering the radiant cooler.	HCMR Cone Cover Enable Deploy/Store is a logical "0".
	Pickup #1 on	Select timing pickup #1.	Logical 1 indicates Pickup #1.
	Pickup #2 on	Select timing pickup #2.	Logical 0 indicates Pickup #2.

5.0 HCMR OPERATION

The following pages contain flow diagrams showing the proper instrument command sequence for various operational conditions. The diagrams outline operation of the HCMR for BCE or spacecraft prelaunch atmospheric pressure, vacuum chamber operation, launch phase operation and cooler outgassing and instrument operation after satellite stabilization in orbit. A digital mode telemetry listing and an analog telemetry listing are also included.

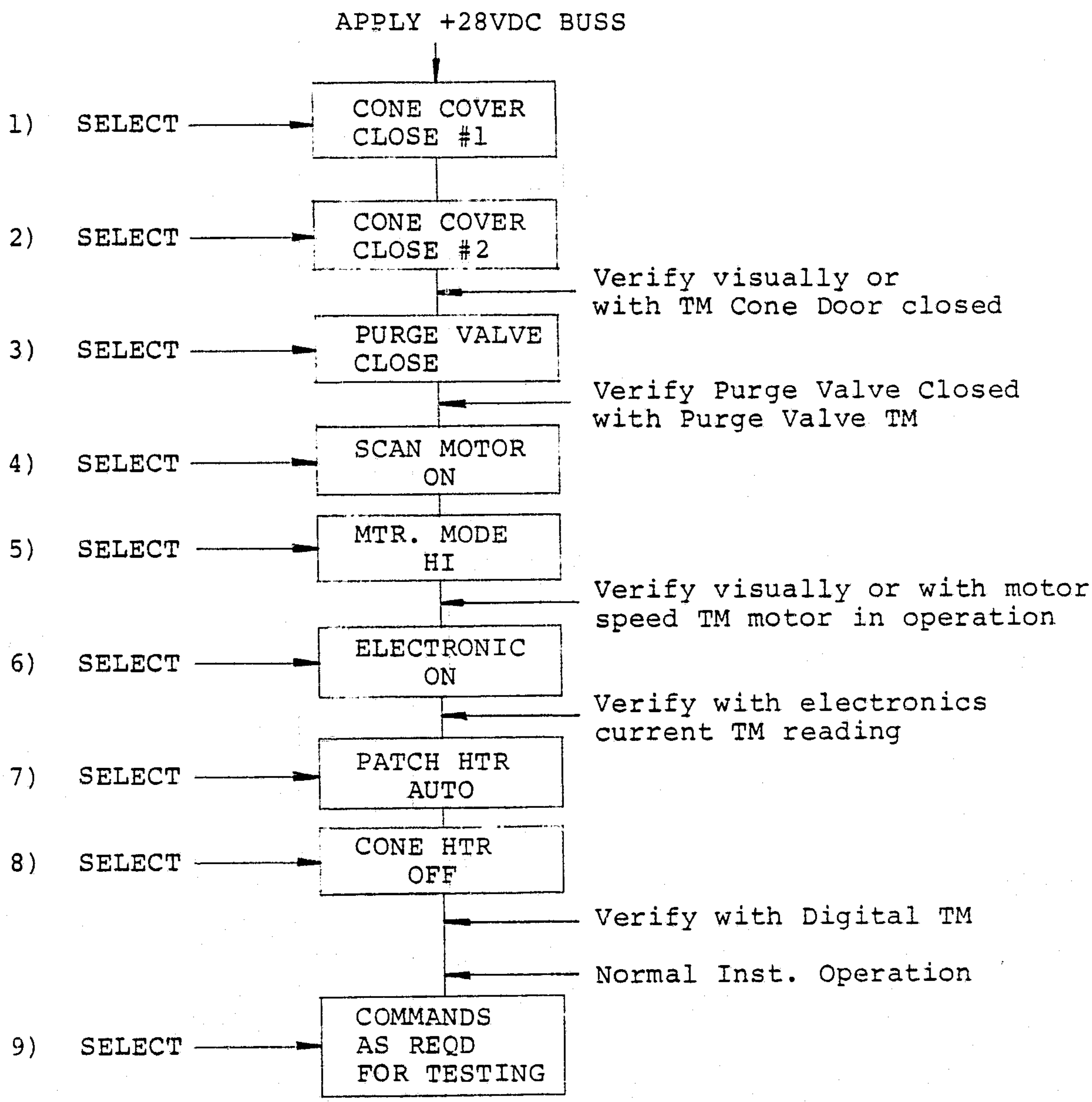
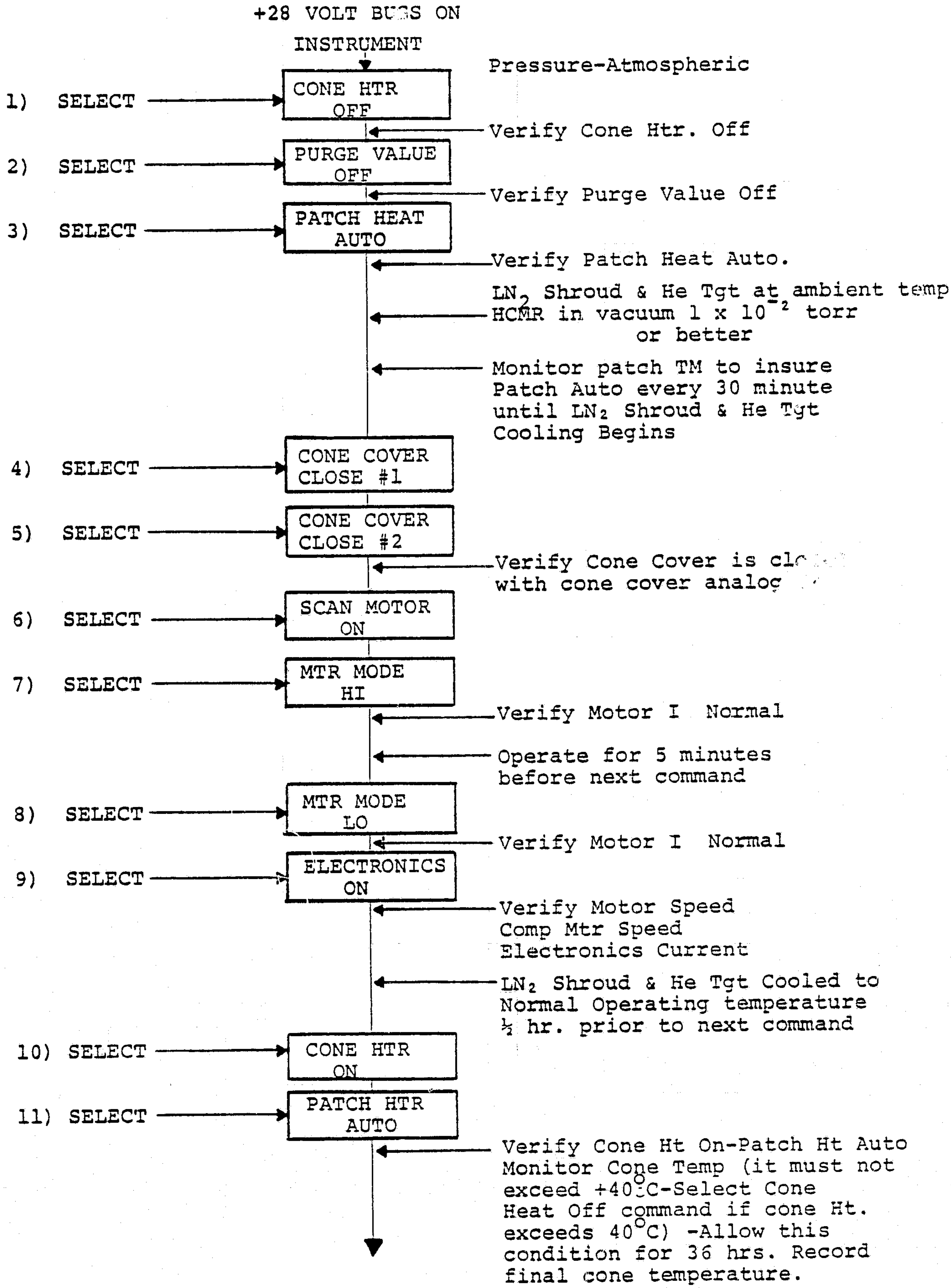


Figure 5-1 BCU & SPACECRAFT PRELAUNCH ATMOSPHERIC PRESSURE OPERATION OF HCMR


+28 VOLT BUSS ON
INSTRUMENT
Pressure-Atmospheric
1) SELECT
CONE HTR OFF
Verify Cone Htr. Off
2) SELECT
PURGE VALUE OFF
Verify Purge Value Off
3) SELECT
PATCH HEAT AUTO
Verify Patch Heat Auto.
LN2 Shroud & He Tgt at ambient temp
HCMR in vacuum 1 x 10-2 torr or better
Monitor patch TM to insure Patch Auto every 30 minute until LN2 Shroud & He Tgt Cooling Begins
4) SELECT
CONE COVER CLOSE #1
5) SELECT
CONE COVER CLOSE #2
Verify Cone Cover is cl
with cone cover analog
6) SELECT
SCAN MOTOR ON
7) SELECT
MTR MODE HI
Verify Motor I Normal
Operate for 5 minutes before next command
8) SELECT
MTR MODE LO
Verify Motor I Normal
9) SELECT
ELECTRONICS ON
Verify Motor Speed
Comp Mtr Speed
Electronics Current
LN2 Shroud & He Tgt Cooled to Normal Operating temperature ½ hr. prior to next command
10) SELECT
CONE HTR ON
11) SELECT
PATCH HTR AUTO
Verify Cone Ht On-Patch Ht Auto
Monitor Cone Temp (it must not exceed +40°C-Select Cone Heat Off command if cone Ht. exceeds 40°C) -Allow this condition for 36 hrs. Record final cone temperature.

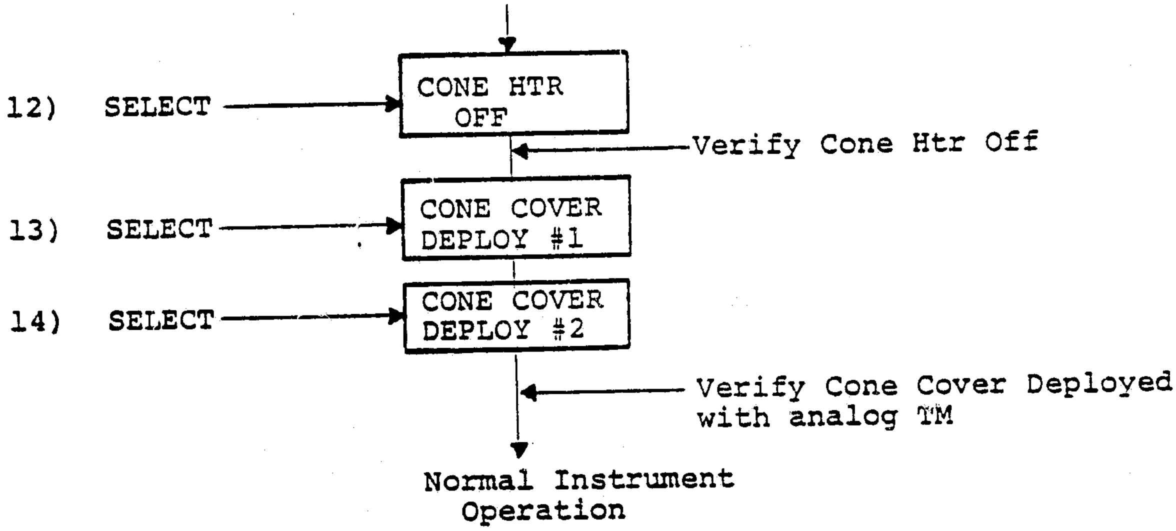


Figure 5-2 CHAMBER OPERATION HCMR

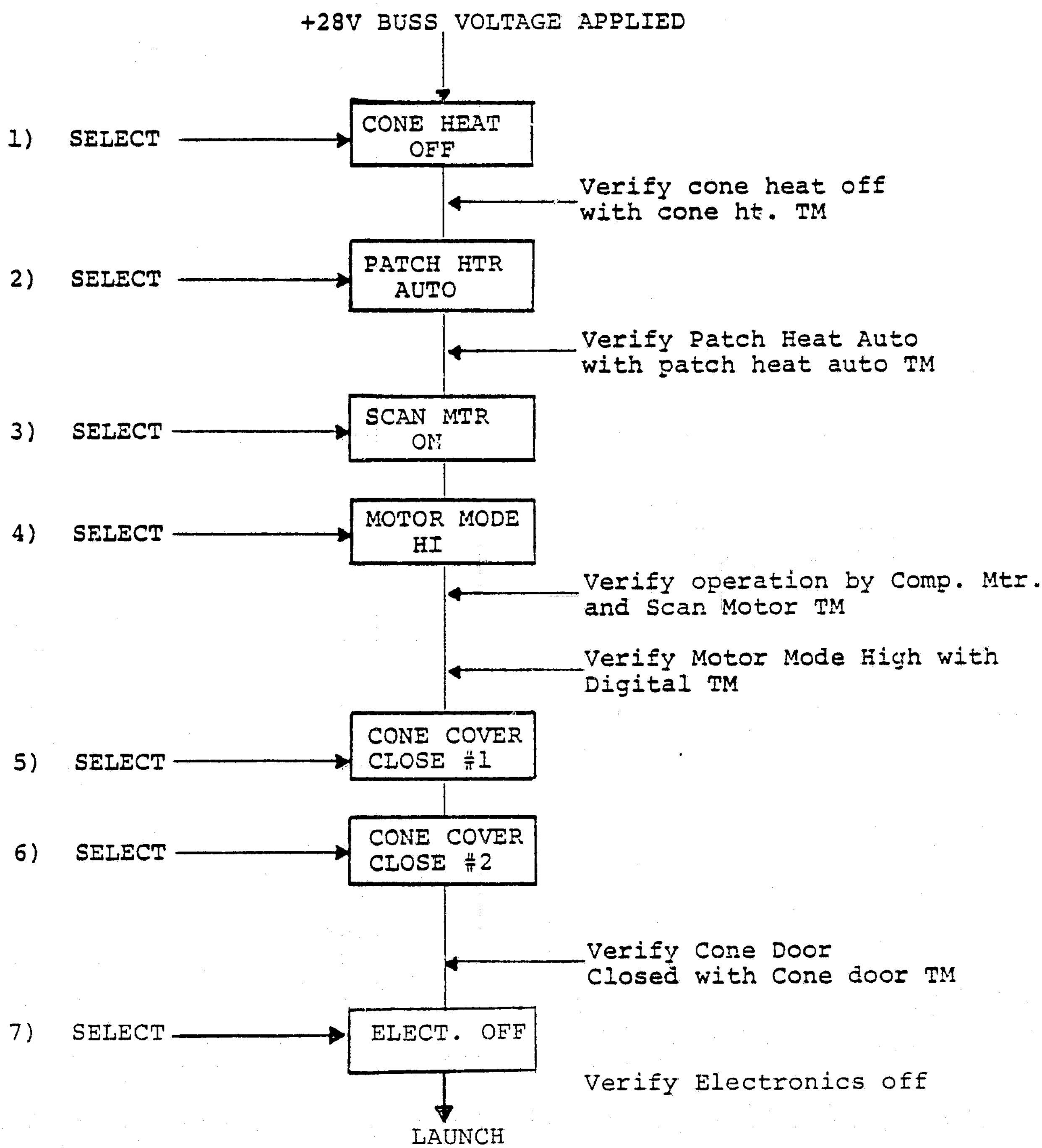


Figure 5-3 LAUNCH PHASE OPERATIONAL SEQUENCE

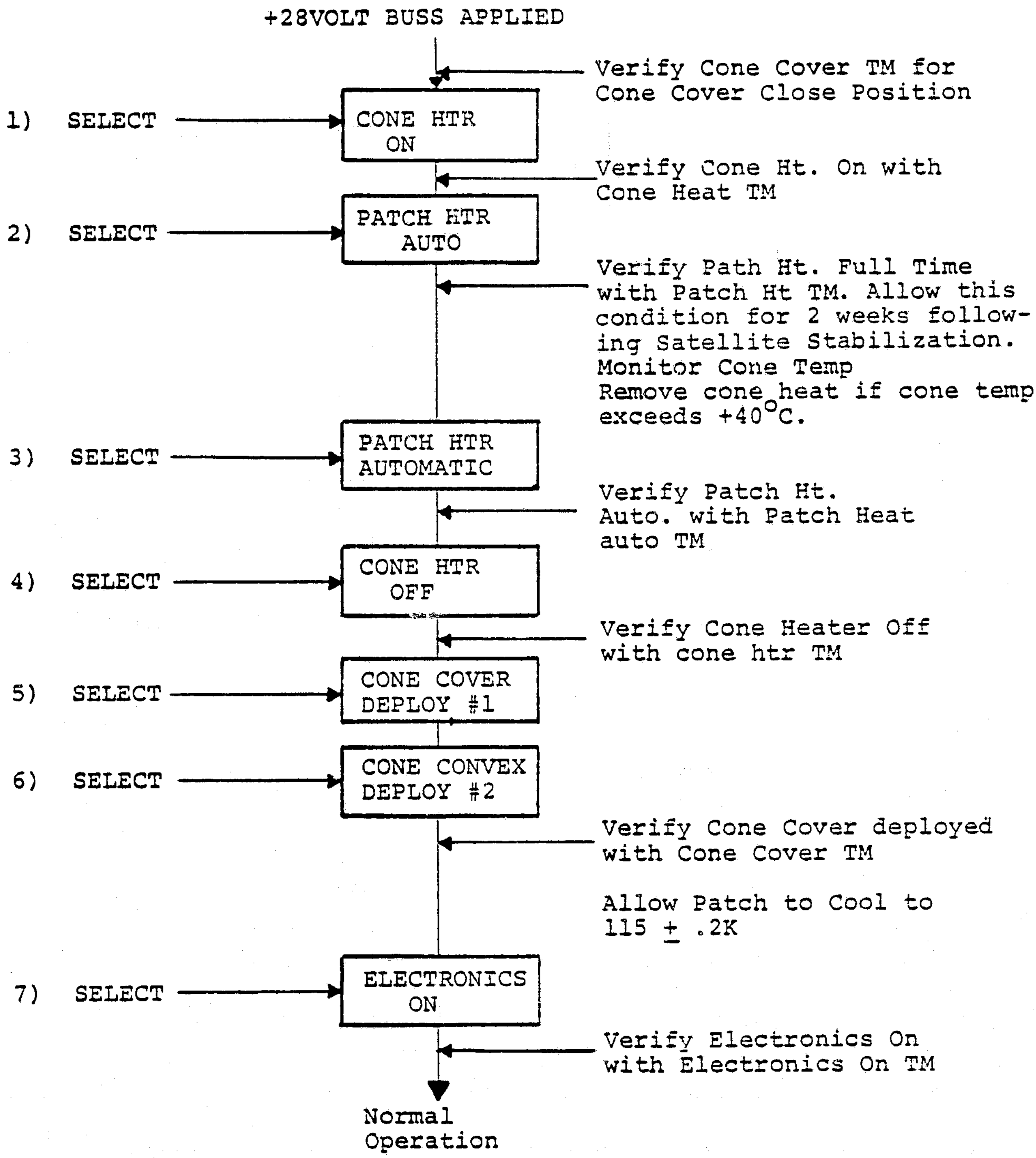


Figure 5-4. Initial Cooler Outgassing and Instrument Operational Sequence Following Spacecraft Stabilization in Orbit.

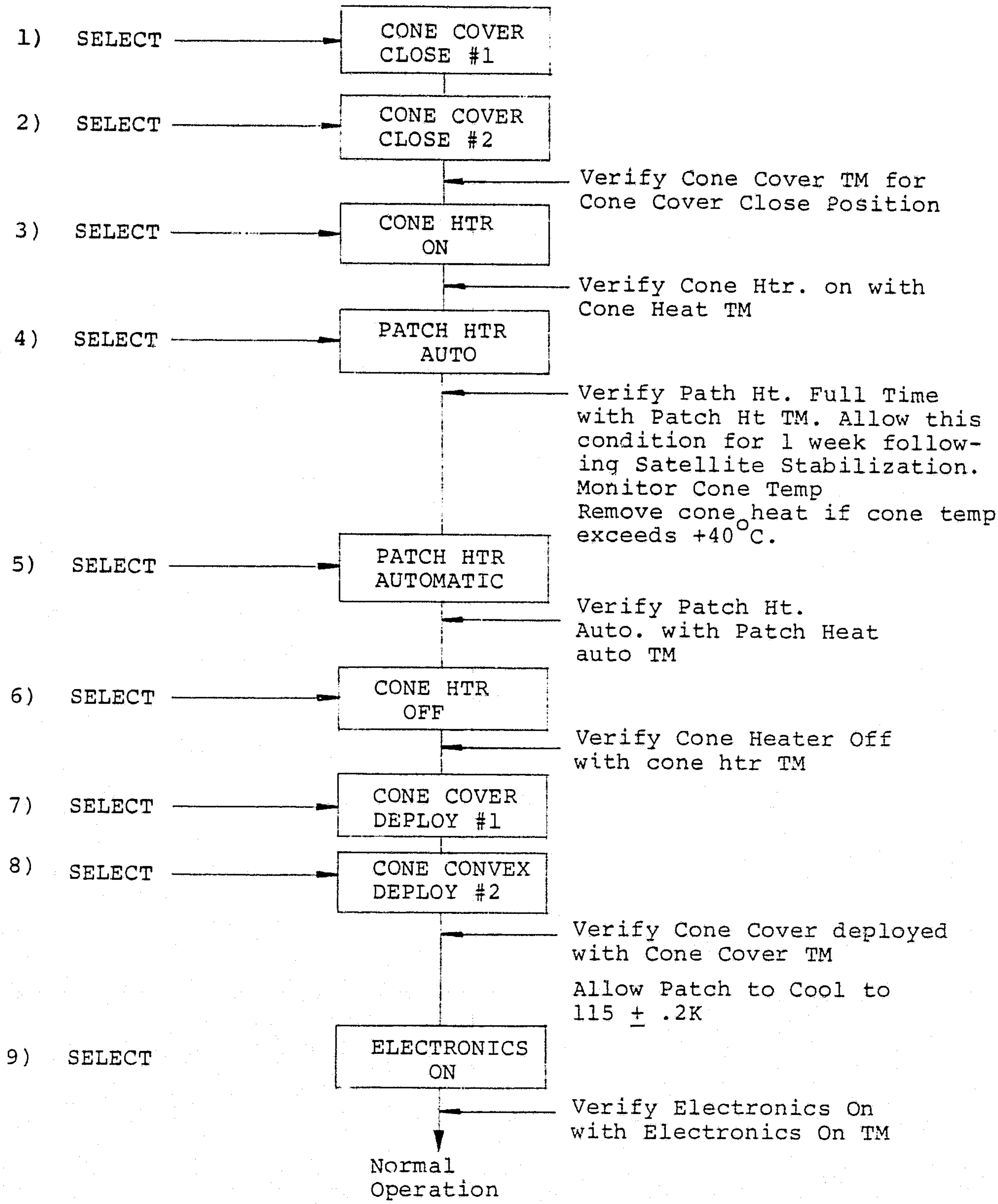


Figure 5-5 Orbital Cooler Outgassing if Required for Decontamination During Operational Lifetime

TABLE 5-1

DIGITAL TELEMETRY MODE VERIFICATION

COMMAND NAME	TELEMETRY VERIFICATION
HCMR Motor Power Mode Low	HCMR Motor Power High/Low Tlm is a logical "1" when motor power is on.
HCMR Patch Heater Full Time	HCMR Patch Heater Tlm is a logical "1".
HCMR Patch Heater Automatic	HCMR Patch Heater Tlm is a logical "0".
HCMR Cone Heater ON	HCMR Cone Heater ON/OFF Tlm is a logical "1".
HCMR Cone Heater OFF	HCMR Cone Heater ON/OFF Tlm is a logical "0".
HCMR Cone Cover Deploy #1	(1) HCMR Cone Cover #1 is a logical "1".
HCMR Cone Cover #2 Deploy	Cone Cover #2 Tlm is a logical "1".
HCMR Cone Cover #1 Close	(1) HCMR Cone Cover #1 Tlm is a logical "0".
HCMR Cone Cover #2 Close	Cone Cover #2 Tlm is a logical "0".
HCMR Purge Valve Open	HCMR Purge valve (Tlm is a logical "1").
HCMR Purge Valve Close	HCMR Purge valve Tlm is a logical "0".
HCMR Mag Pick-up Channel #1	HCMR Mag Pickup Tlm is a logical "1".
HCMR Mag Pick-up #2	HCMR Mag Pickup Tlm is a logical "0".

TABLE 5-2 : HCMR TELEMETRY LIST

Analog Telemetry

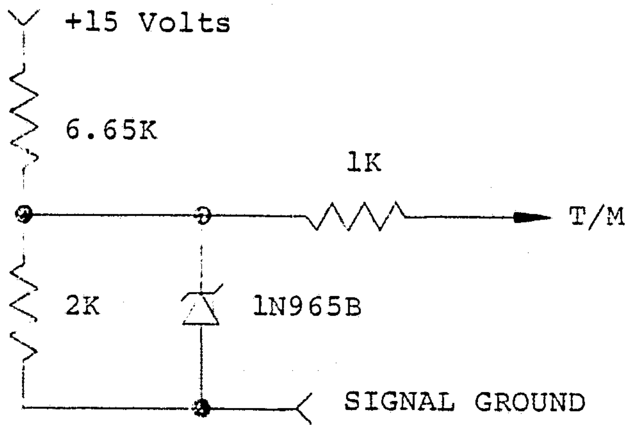
Function	Position Name	Type	Sampl Rate	Pwr Source	Ref. Para.
	+15 Volt*	Analog		CP	3.1
	+ 5 Volt*	Analog		CP	3.2
	-15 Volt*	Analog		CP	3.3
	Telemetry Power	Analog		CP	3.4
	Detector #2 Bias*	Analog		CP	3.6
	Motor Drive Current	Analog		CP	3.9
	Cone Cover Position*	Analog		CP	3.10
	Electronics Temp.	Analog		CP	3.9
	Baseplate Temp.	Analog		CP	3.10
	Cone Temperature	Analog		CP	3.8
	Patch Temperature	Analog		CP	3.7
	Blackbody - Temp #1	Analog		CP	3.11
	Blackbody - Temp #2	Analog		CP	3.12
	Purge Pressure	Analog		CP	3.24
	Cone Wall HSG Temp	Analog		CP	3.
	Patch Power	Analog		CP	3.
	Elect. Current	Analog		CP	3.
	Offset Voltage	Analog		CP	
	Momentum Comp Sp	Analog		CP	
	Scan Motor Sp	Analog		CP	
	Mtr. HSG Temp.	Analog		CP	
			Digital TM		
	Motor Status	Digital		CP	3.15
	Electronics Status	Digital		CP	3.16
	Motor Pwr Status	Digital		CP	3.17
	Patch Heater Status	Digital		CP	3.18
	Cone Heater Status	Digital		CP	3.19
	Cone Cover Status #1	Digital		CP	3.20
	Purge Valve Status	Digital		CP	3.21
	Cone Cover Status #2	Digital		CP	3.22

6.0 TELEMETRY

The telemetry associated with HCMR subsystem is listed in Table 4.

6.1 +15 Volt Monitor

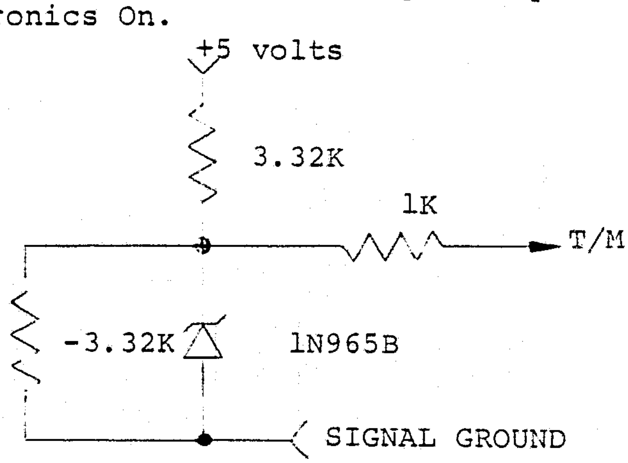
This function monitors the +15 volt output of the HCMR regulator. The +15 volt buss powers the +12 volt regulators associated with the detector pre-amps and all operational amplifiers except those used in the telemetry circuits.



+15 VOLT TELEMETRY DERIVATION SCHEMATIC

6.2 +5 Volt Monitor

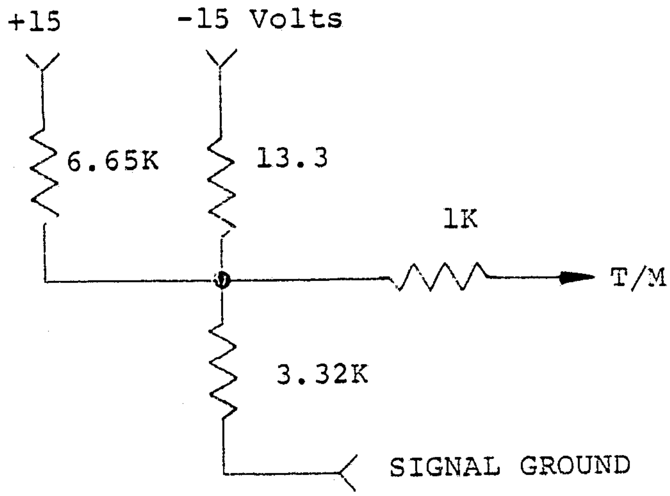
This function monitors the +5 volt regulator output. The +5 volt buss provides the supply voltage for all digital microcircuits. The +5 volt buss is energized upon execution of the command Electronics On.



+5 VOLT TELEMETRY DERIVATION SCHEMATIC

6.3 -15 Volt Monitor

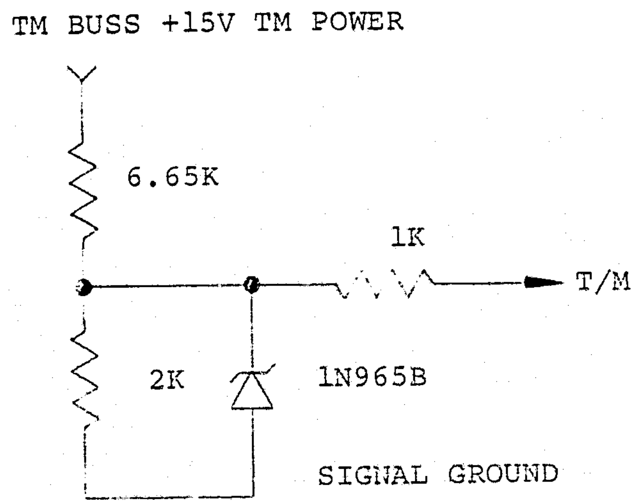
This function monitors the -15 volt regulator output. The -15 volt buss powers the preamplifier -12 volt regulators, supplies operating voltages for the operational amplifiers and powers the analog telemetry points noted by an asterisk in Table 4. The -15 volt buss is energized upon execution of the command Electronics On.



-15 VOLT TELEMETRY DERIVATION SCHEMATIC

6.4 Telemetry Power

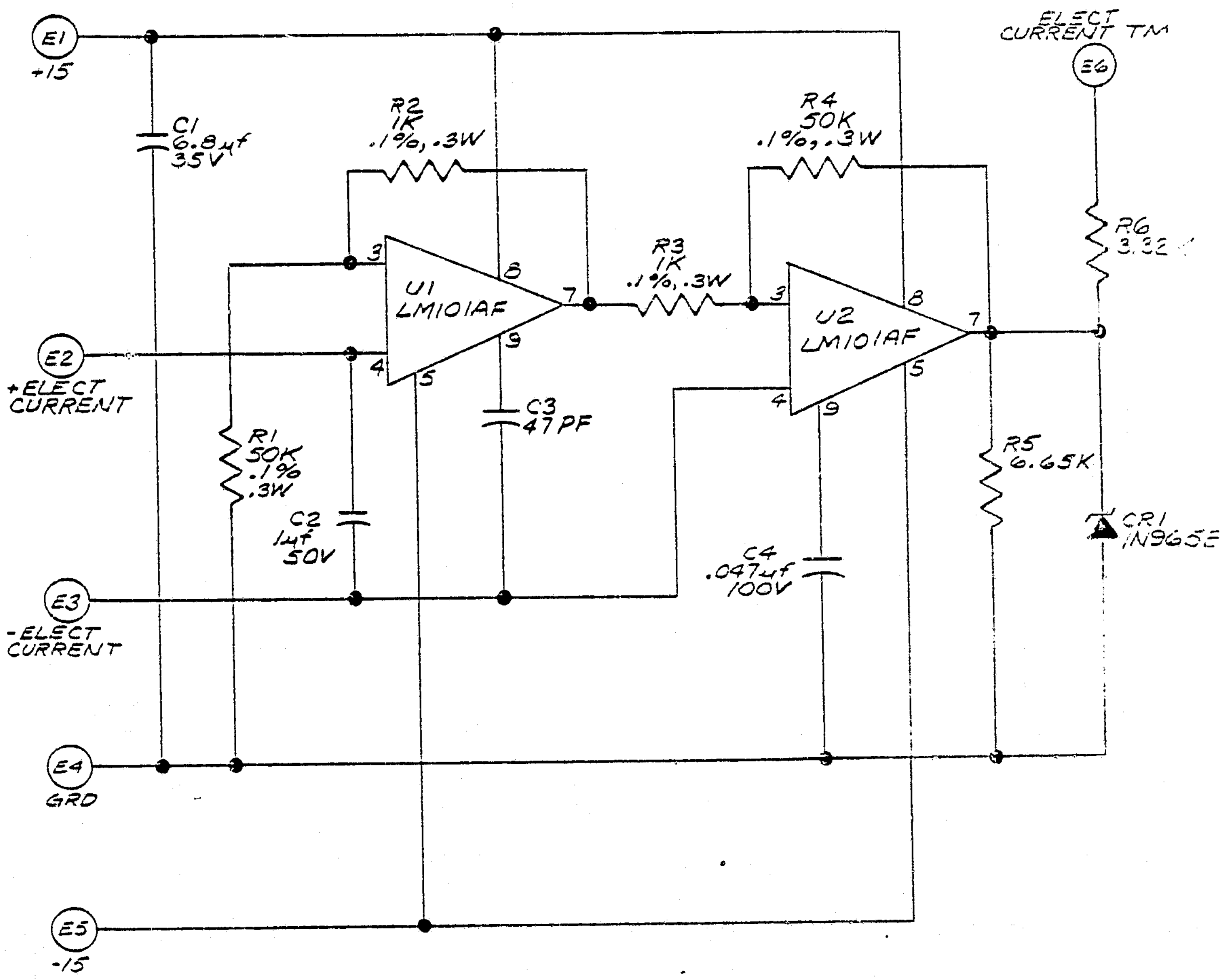
This function monitors the telemetry regulator buss voltage. The telemetry buss powers all temperature telemetry monitors. Telemetry power is energized at execution of the commands Motor On or Electronics On.



TELEMETRY VOLTAGE TELEMETRY DERIVATION SCHEMATIC

6.5 <u>Electronic Current TM</u>

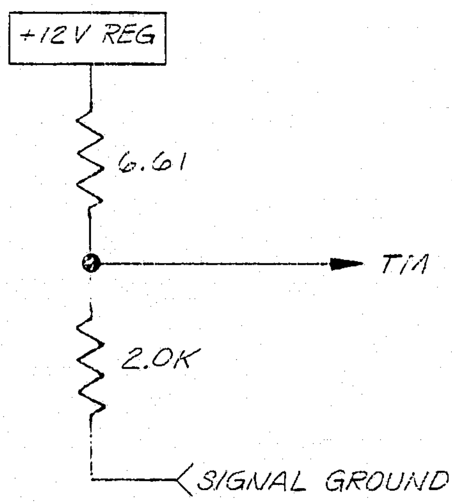
This circuit monitors total instrument current from the +28 volt buss.



It is activated by Motor Power on and/or Electronics Power on.

6.6 Preamp Power

This function monitors the output of the +12 volt regulator of the Channel 2 preamplifier. This +12 volt regulator provides detector bias and supply voltages for the Channel 2 pre-amplifier operational amplifiers. The +12 volt buss is energized upon execution of the command Electronics On.



PREAMP POWER TELEMETRY DERIVATION SCHEMATIC

6.7 Patch Temperature

This function monitors the temperature of the 115° Kelvin patch upon which the detectors are mounted. This telemetry monitor is energized upon execution of the commands Motor On or Electronics On. (See Patch and Cone Wall Temperature Telemetry Derivation Schematic.)

6.8 Cone Wall Temperature

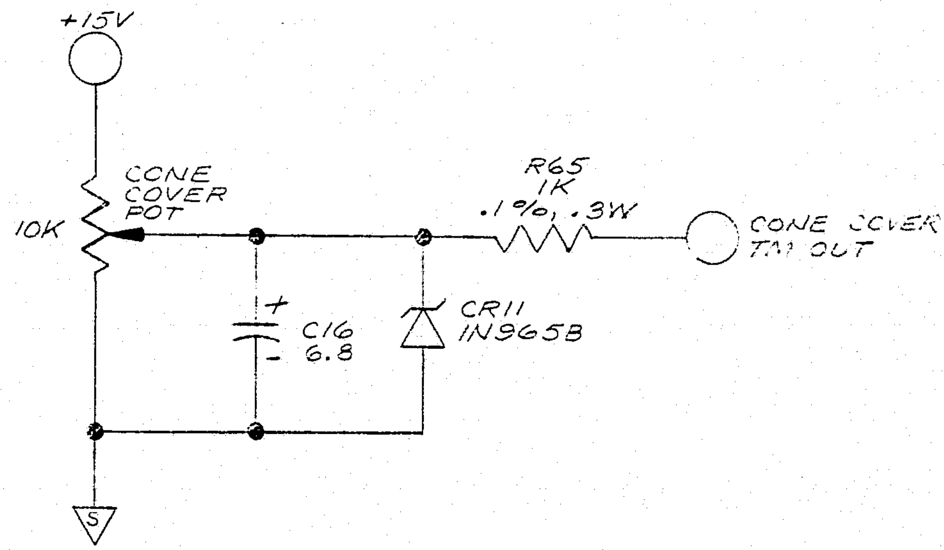
This function monitors the temperature of the radiant cooler cone walls. This monitor is energized upon execution of the commands Motor On or Electronics On. (See Patch and cone wall temperature Telemetry Derivation Schematic.)

6.9 Electronics Temperature Monitor

This function monitors the temperature of the electronics section of the instrument. The telemetry derivation circuit is powered by the telemetry regulator which is energized upon execution of the commands Motor On or Electronics On. (See the temperature Telemetry Derivation Schematic.)

6.10 Cone Cover Position Monitor

This function monitors the position of the cone cover.



CONE COVER POSITION TELEMETRY DERIVATION SCHEMATIC

6.11 Blackbody Temperature #1

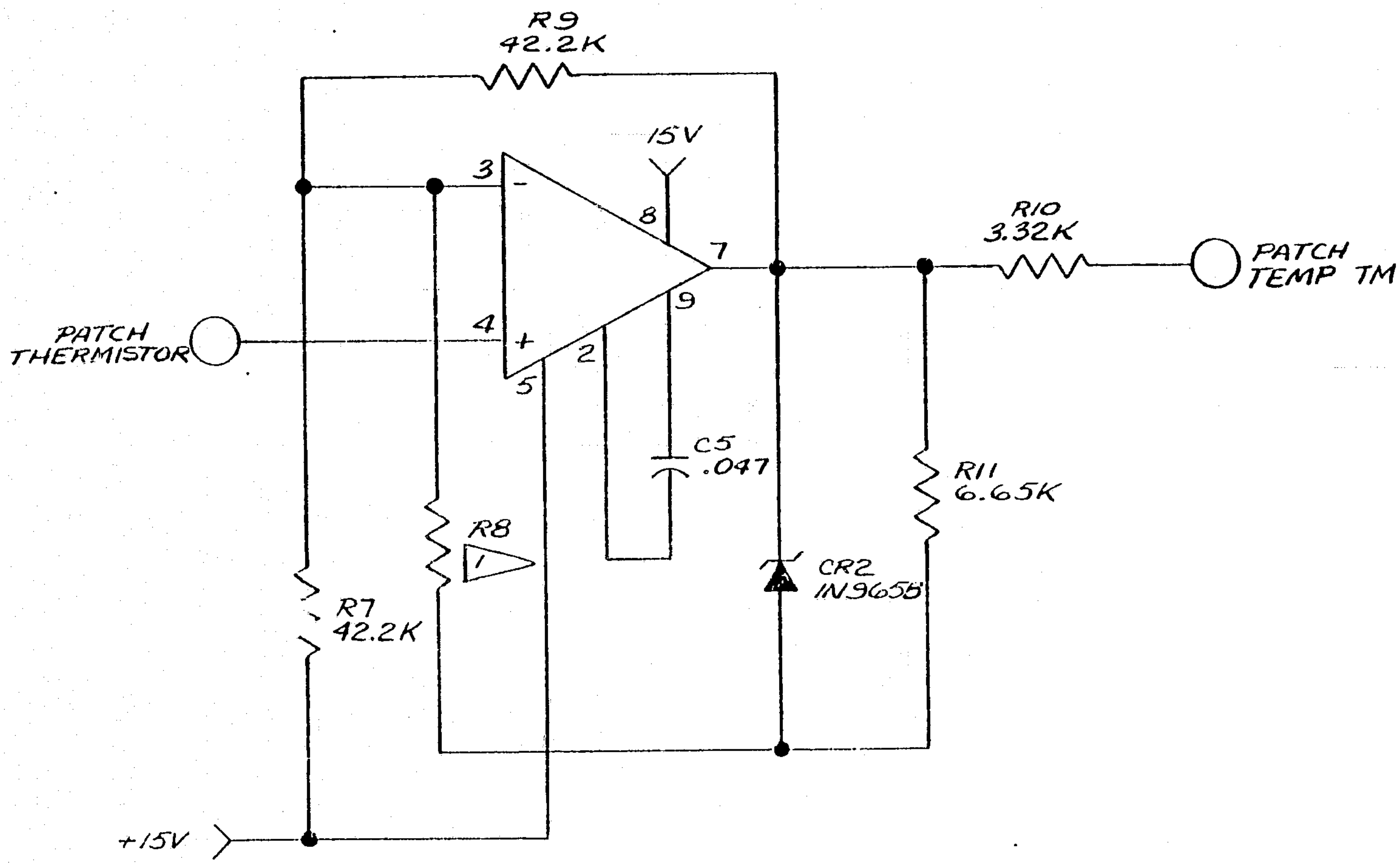
This function monitors the temperature of the internal Blackbody Target. The telemetry derivation circuit is powered by the telemetry regulator which is energized upon execution of the commands Motor On or Electronics On. (See the Temperature Telemetry Derivation Schematic).

6.12 Blackbody Temperature #2

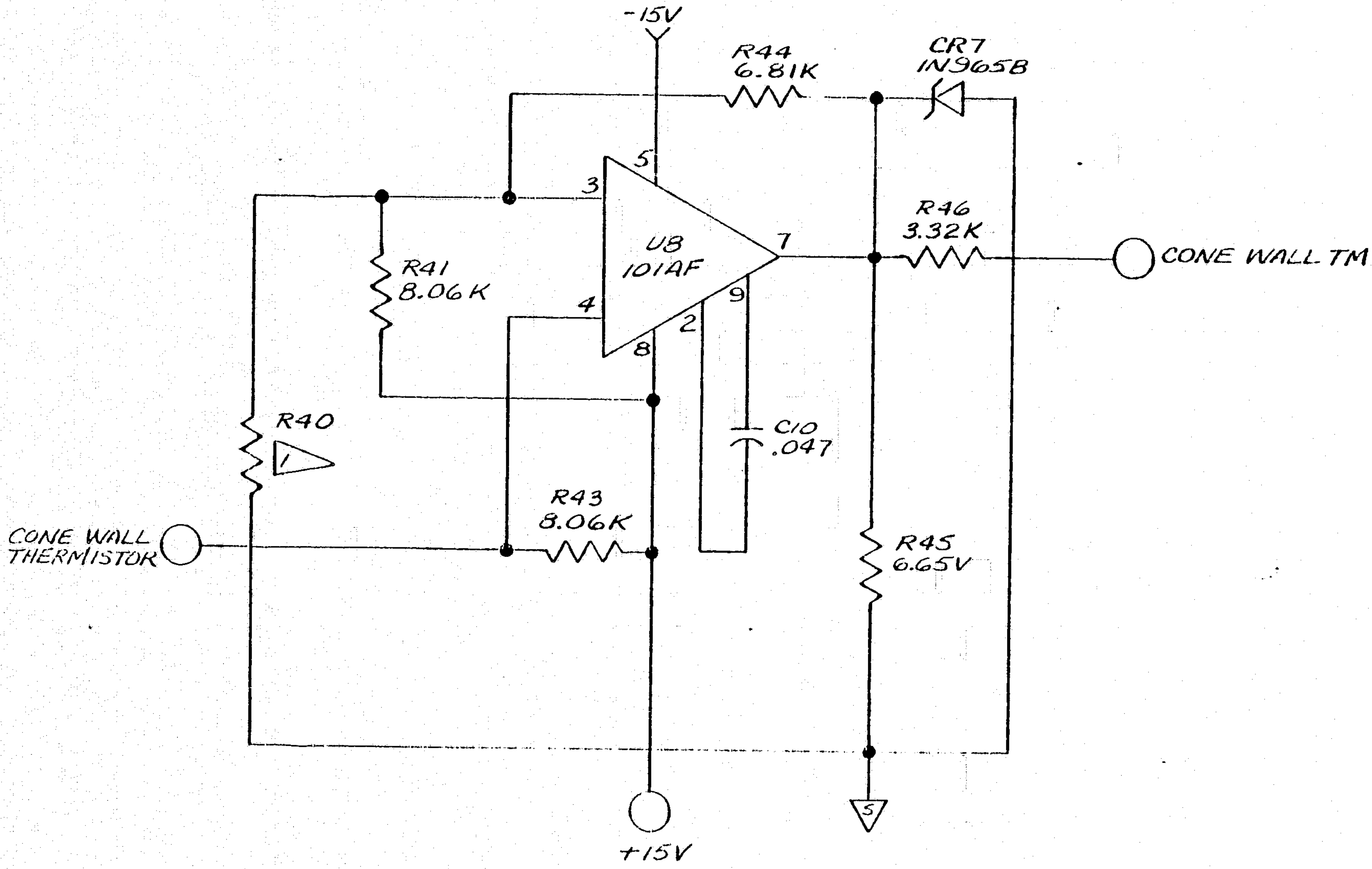
This function monitors the temperature of the internal calibration blackbody. The telemetry derivation circuit is powered by the telemetry regulator which is energized upon execution of the commands Motor On or Electronics On. (See the Temperature Telemetry Derivation Schematic.)

6.13 Baseplate Temperature Monitor

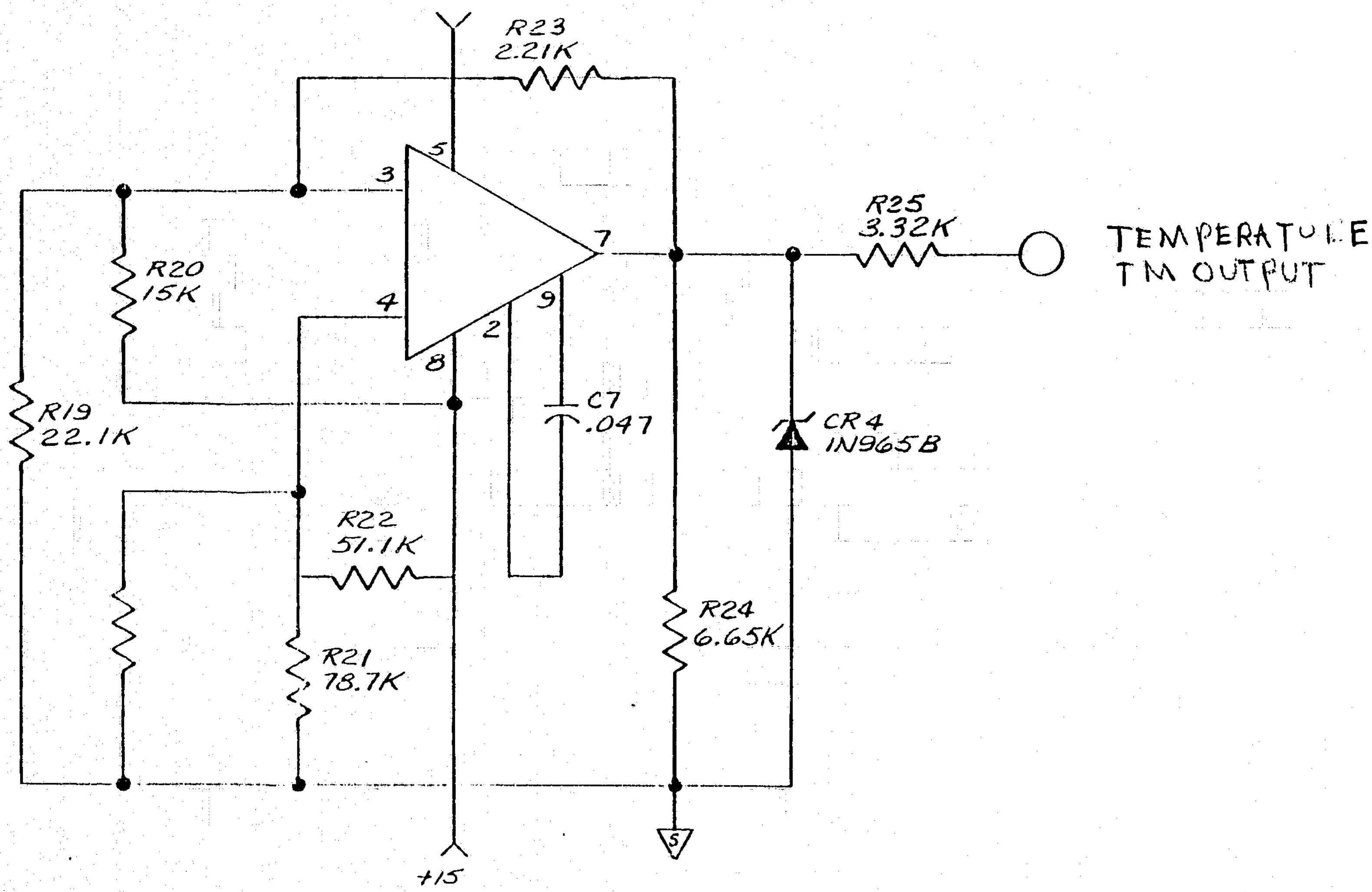
This function monitors the temperature of the instrument baseplate. The telemetry derivation circuit is powered by the telemetry regulator which is energized upon execution of the commands Motor On or Electronics On. (See the Temperature Telemetry Derivation Schematic.)



PATCH TEMPERATURE TELEMETRY DERIVATION SCHEMATIC



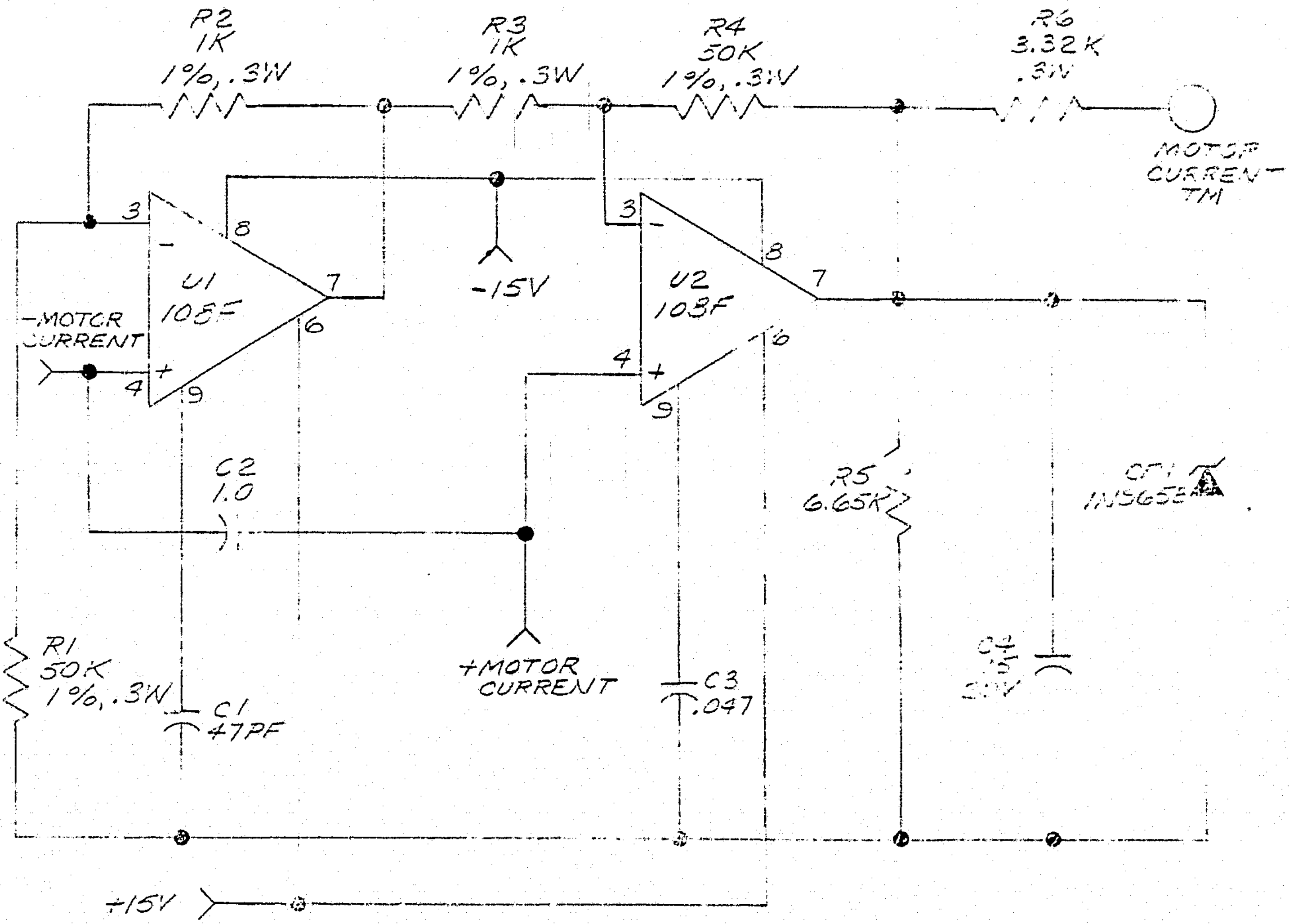
CONE WALL TEMPERATURE TELEMETRY DERIVATION SCHEMATIC



TEMPERATURE TELEMETRY DERIVATION SCHEMATIC

6.14 Motor Drive Current Monitor

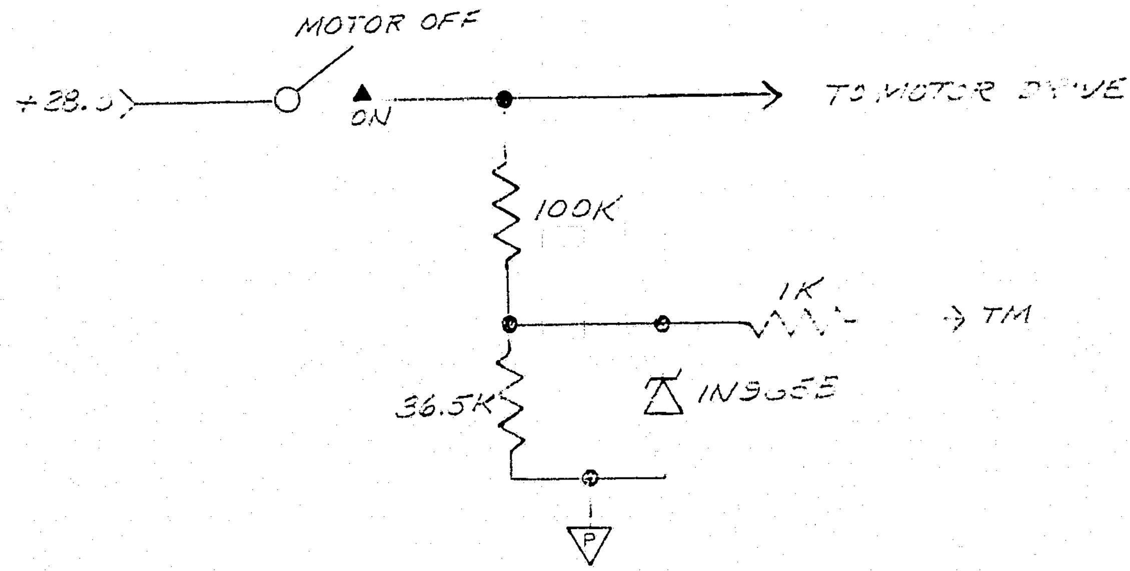
This function monitors the current being drawn by the scan mirror motor. This telemetry monitor is energized upon execution of the command Motor On.



MOTOR CURRENT TELEMETRY DERIVATION SCHEMATIC

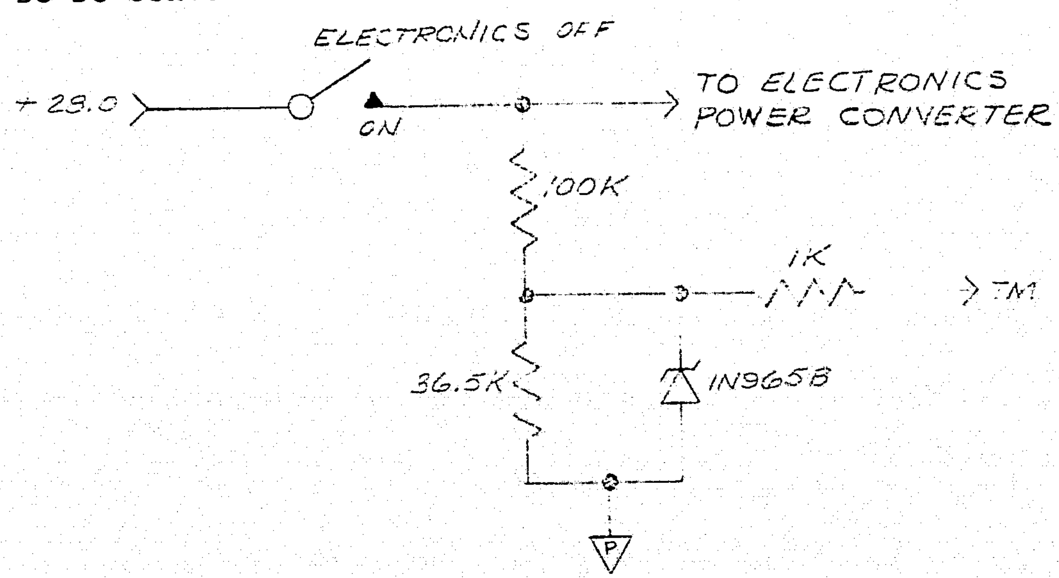
6.15 Motor Status

This function monitors the state of the Motor On/Off Command Relay. Execution of the Motor On command connects the regulated buss to the motor power supply, switching Regulator, and telemetry power converter.



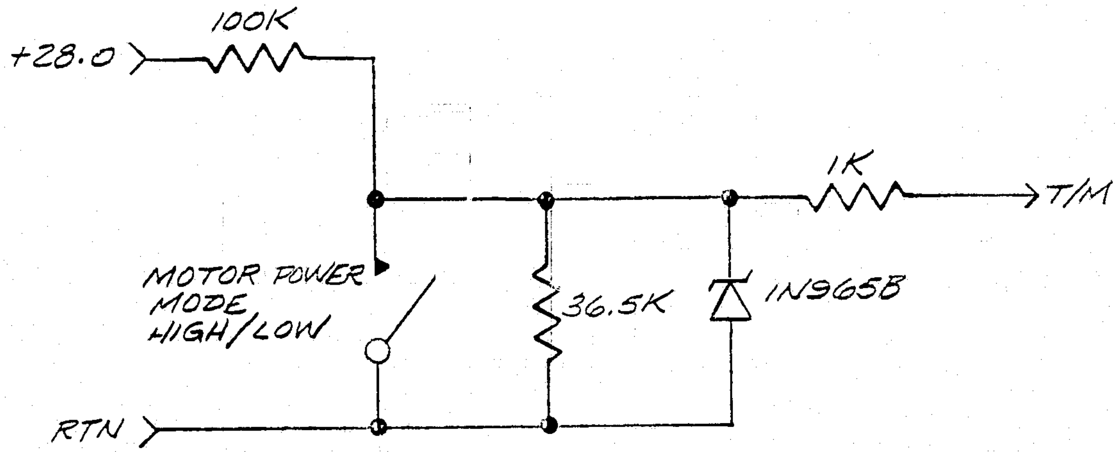
6.16 Electronics Status

This function monitors the operation of the Electronics On/Off relay. The Electronics On command energizes the main DC-DC converter if the Motor On command has not been energized.



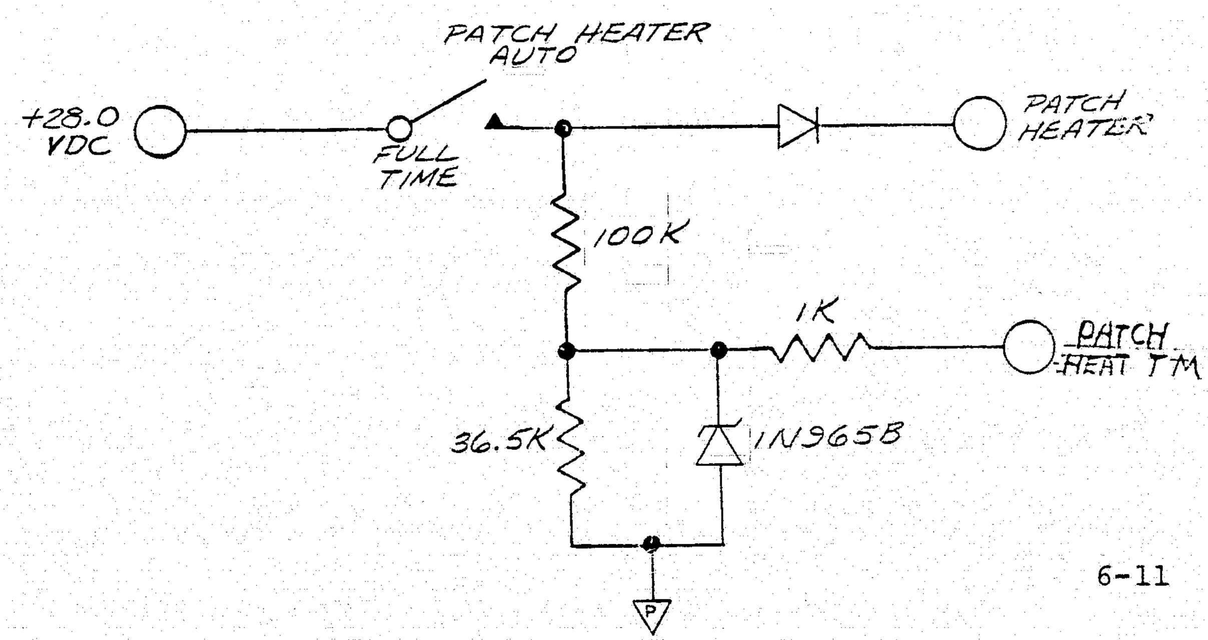
6.17 Motor Power Status

This function monitors the operation of the motor power relay.



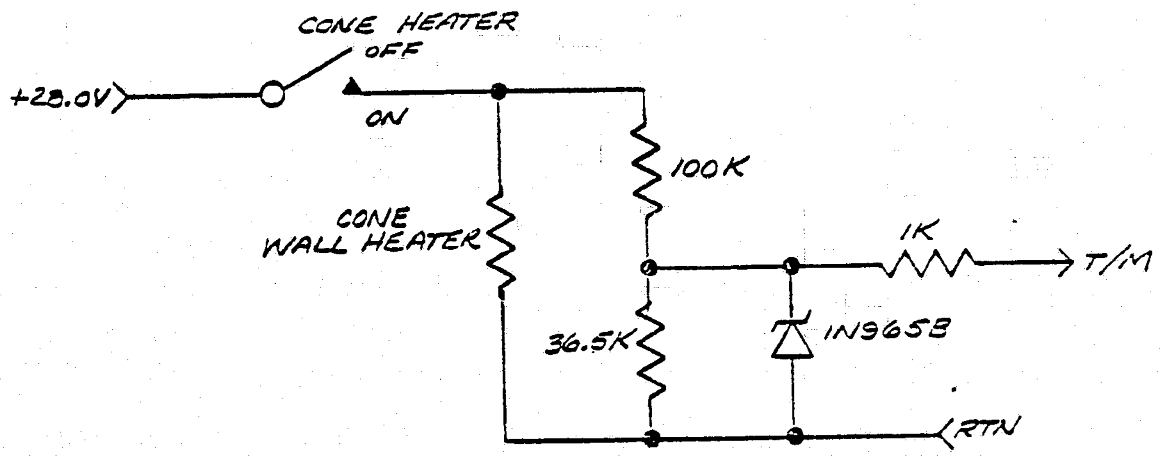
6.18 Patch Heater Status

This function monitors the operation of the Patch Heater Full Time/Automatic relay. Execution of the Patch Heater Full Time Command applies +28.0 volts to the patch heater. Execution of the Patch Heater Automatic Command removes +28.0 volts from the patch heater and returns heater voltage control to the Patch temperature control circuit.



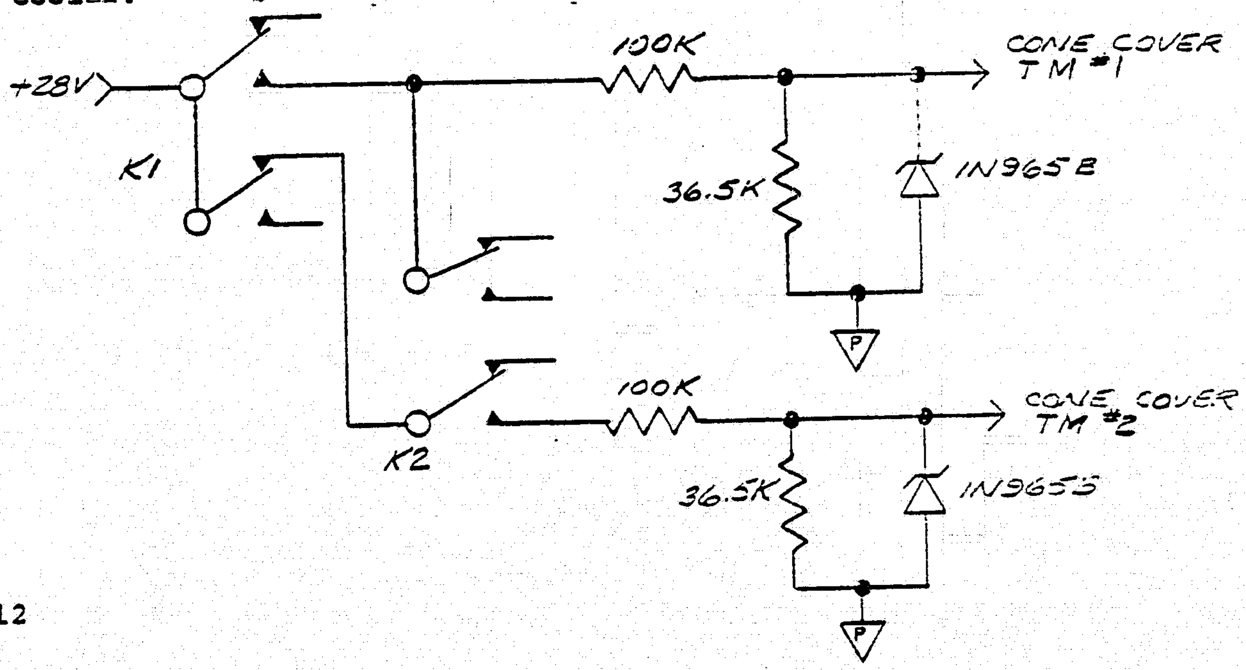
6.19 Cone Heater Status

This function monitors operation of the Cone Heater On/Off Command Relay. Execution of the Cone Heater On Command applies power to the cone heater and execution of the cone heater off command removes power from the Cone Heater.



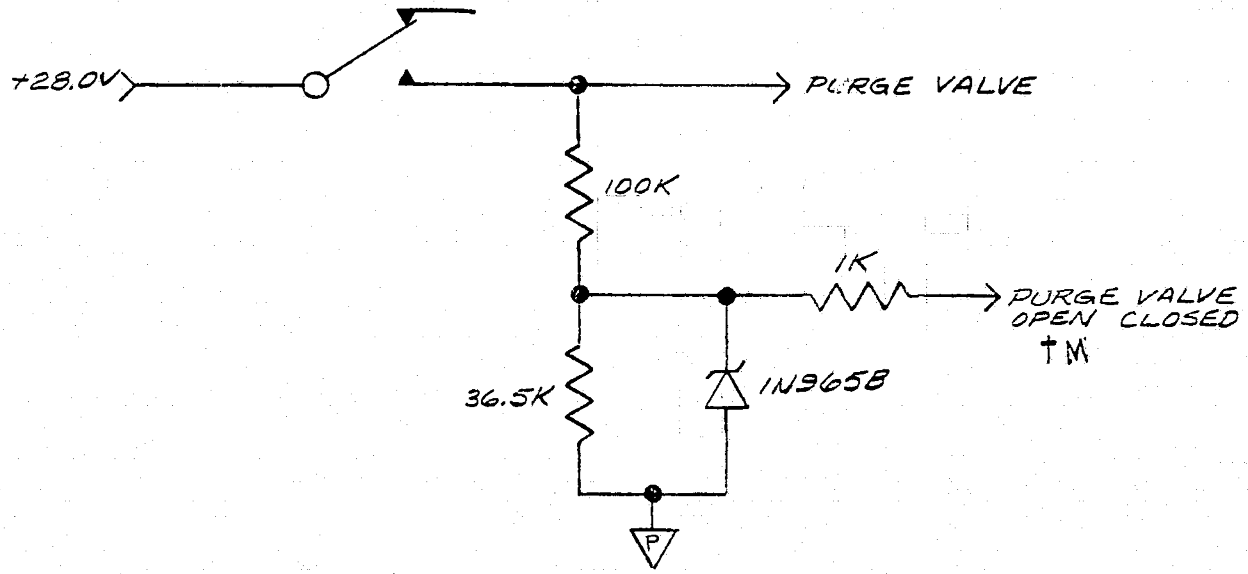
6.20 Cone Cover No. 1 Status

This function monitors operation of the Cone Cover Close/Deploy Commands. Execution of 2 series Cone Cover Deploy Commands causes the cone cover to be deployed as an earth albedo shield for the radiant cooler. Execution of 2 series Cone Cover Close Commands results in the Cone Cover being stored over the face of the radiant cooler.



6.21 Purge Valve Status

Execution of the purge Valve open command opens the solenoid valve between the dry nitrogen storage bottle and the anti-frost enclosure, permitting the AFE to be purged by the on board gas supply. Execution of the Purge Valve Close Command closes the valve shutting off the on board purge.

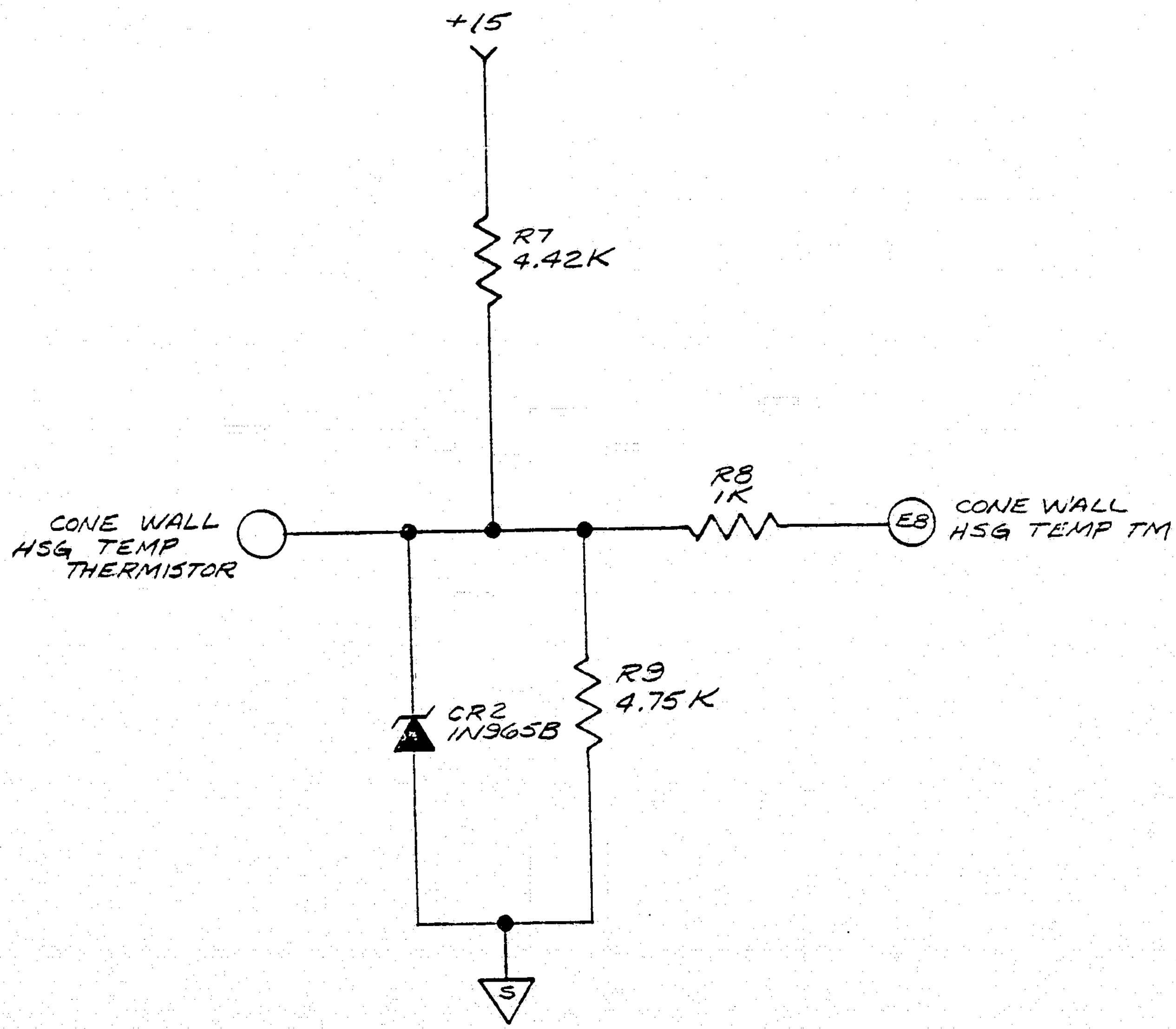


6.22 Cone Cover Enable Status

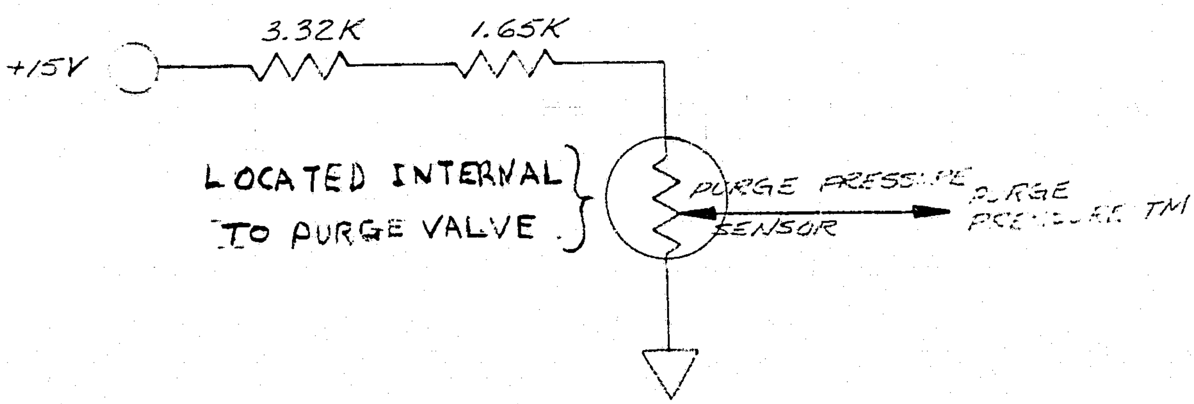
Execution of the Cone Cover Enable Deploy Command sets relay K1 such that the execution of the cone cover Deploy command results in the cone cover deployment. Execution of the Cone Cover Enable Store Command sets relay K1 such that execution of the command Cone Cover Store causes the cone cover to retract. See schematic of Paragraph 3.20.

6.23 Cone Wall HSG Temp. TM

This circuit measures the cone wall Housing temperature.

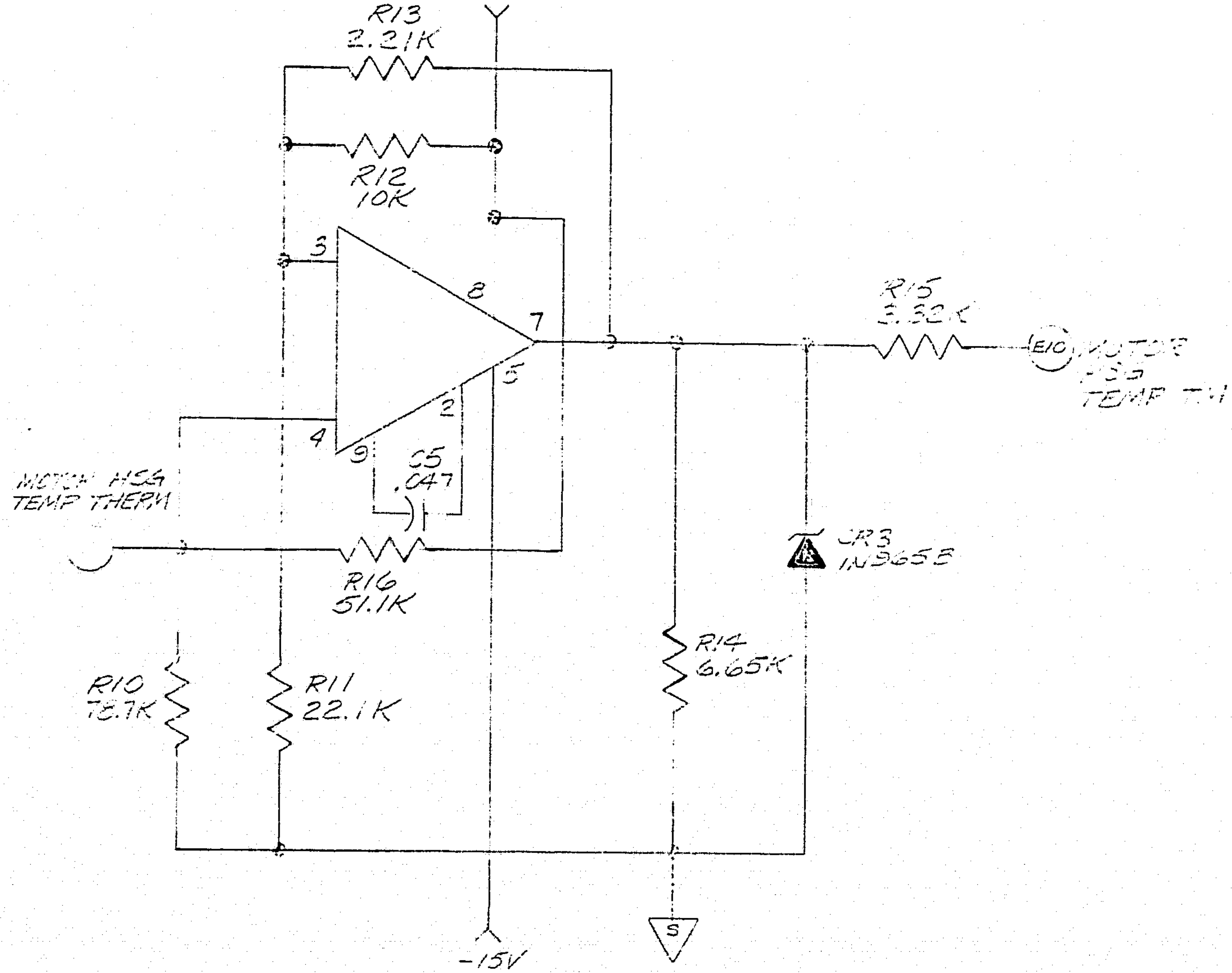


6.24 Purge Tank Pressure



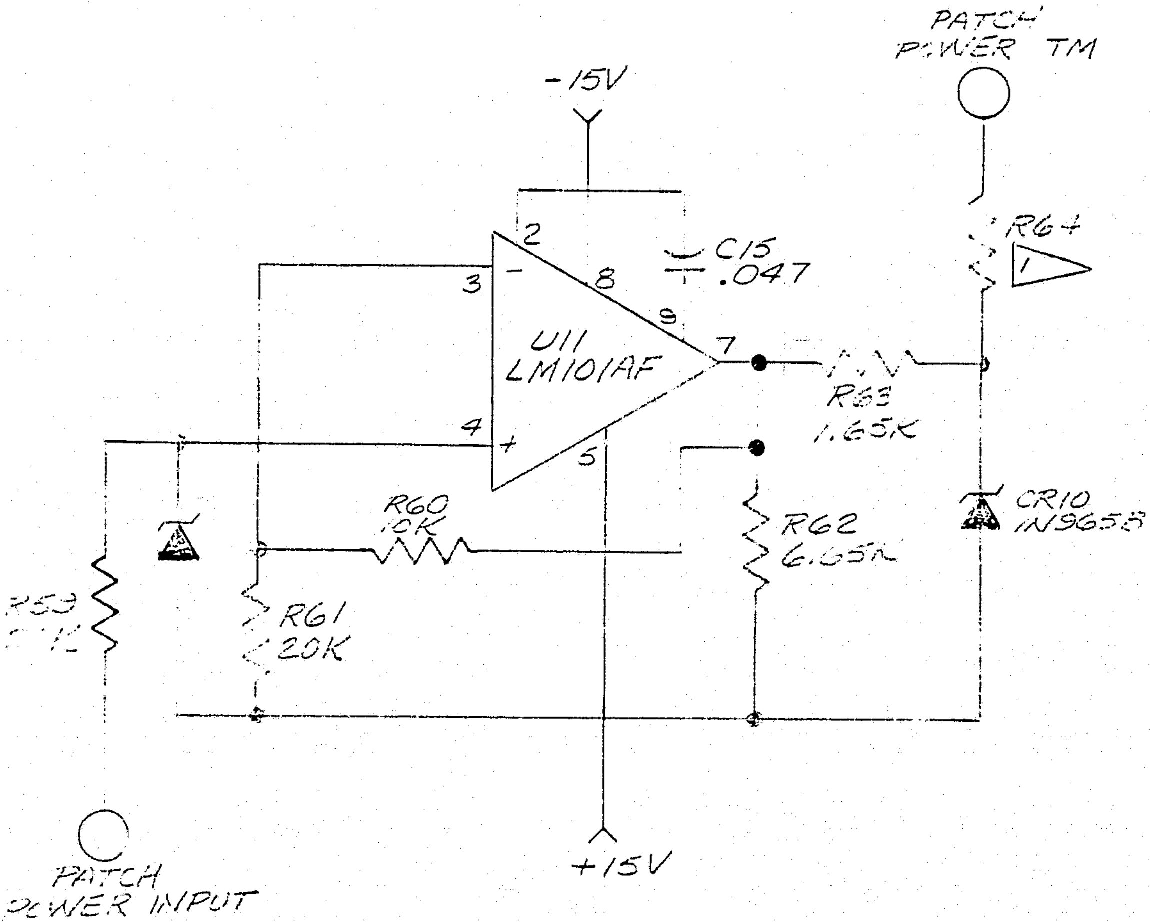
6.25 Motor HSG Temp. TM

This circuit measures the Motor HSG temperature.



6.26 Patch Power T/M

This circuit monitors the patch power. The output voltage is proportional to milliwatts of patch power.



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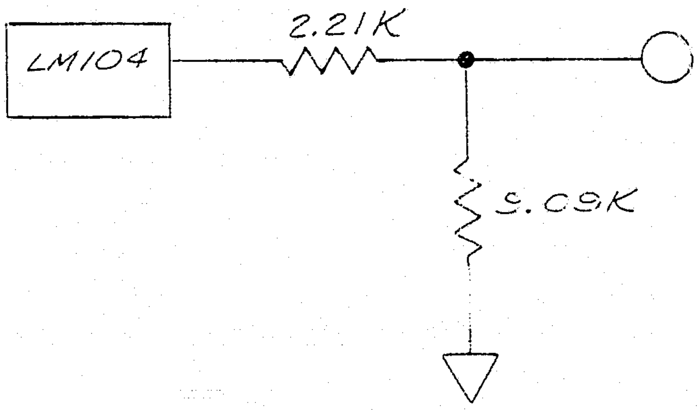
6.27 Offset Voltage TM

This circuit measures the stability of the offset voltage added to the IR signal. This voltage is added to utilize the 0 to 6VDC output magnitude to represent the temperature range 260K to 340K.

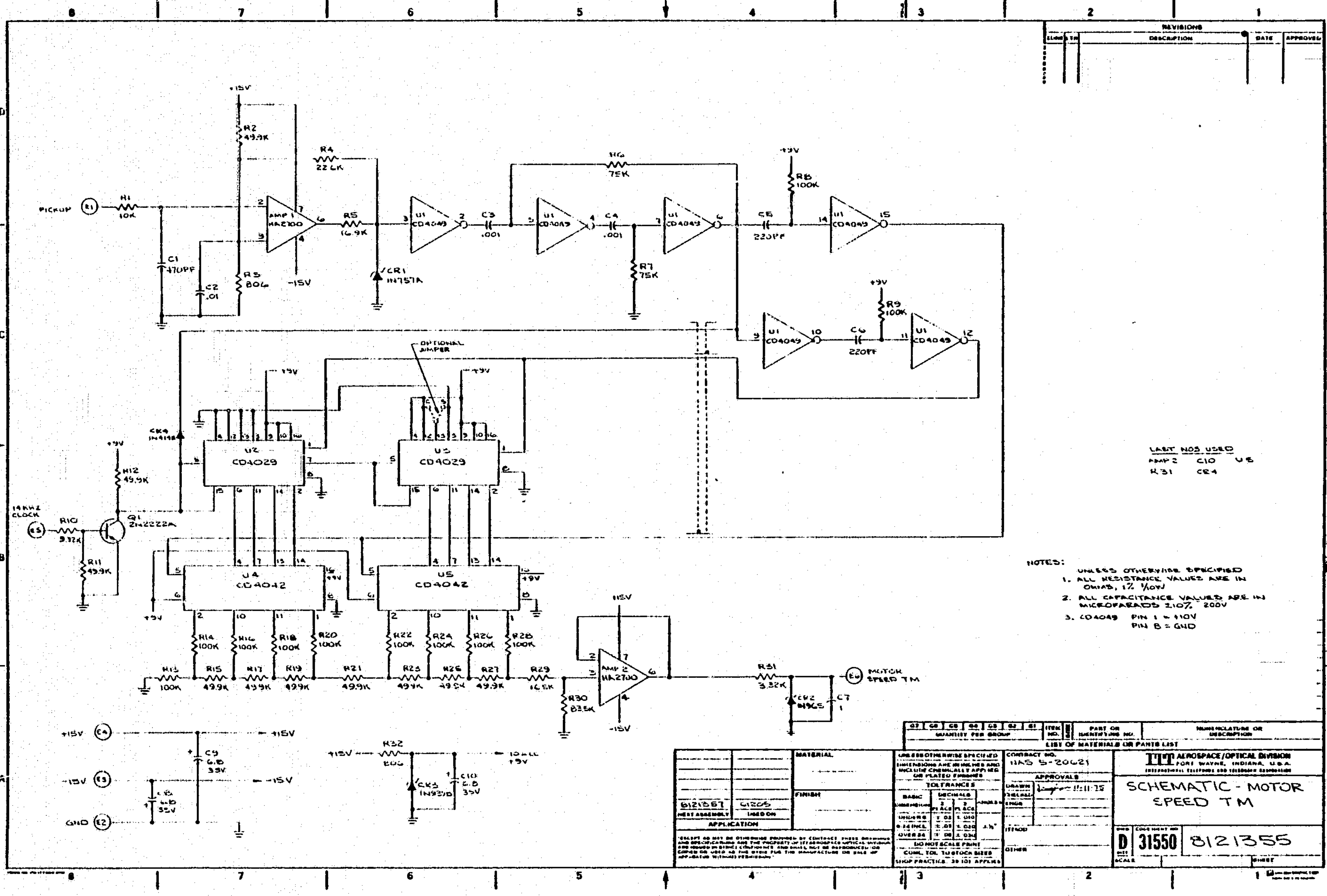


6.28 Momentum Compensator Speed TM

This circuit measures the Momentum compensator speed. The circuit is shown in Schematic #8121355 on the nex page. Speed can be measured over the range 2100 to 5800 RPM.

6.29 Scan Motor Speed TM

This circuit monitors the scan motor speed. The circuit is shown in Schematic #8121355 on the next page. Scan Motor Speed can be measured over the range 680 to 860 RPM.



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7.0 HCMR SIGNAL CHARACTERISTICS TABLES

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Video Signals (J1) DAM-15S-MFB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE		Signal Type	VOLTAGE RANGE	
						Source	Load		Min	Max
1	#22	1	T2S	3	Ch #1 Video	15 Ω	20K Ω	Analog-70KHz	0	+6.0
2	#22	1	T2S	3	Ch #1 Signal Ground	--	--	Sig Ground	--	--
3	--	--	--	-	Shield for J5N01 Pins 1 & 2	--	--			
4					No connection	--	--			
5	#22	2	T2S	7	Ch #2 Video	15 Ω	20K Ω	Analog-70KHz	0	+6.0
6	#22	2	T2S	7	Ch #2 Signal Ground	--	--	Sig Ground	--	--
7	--	--	--	--	Shield for J5N01 Pins 5 & 6					
8					No Connection					
9										
10										
11										
12										
13					No Connection					
14					Power Ground					
15					Chassis Ground					

NOTE 1: Over wrap harness with copper tape and mylar. Tie shield to chassis ground at both ends.

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Test (J2) DCM-37S-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1					Data Out Channel 1	2200 Ω		Analog	0	+6.0
2					Data Out Channel 2	2200 Ω		Analog	0	+6.0
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13					+12V DC Preamp #1	2000 Ω				
14					-12V DC Preamp #1	2000 Ω				
15					+12V DC Preamp #2	2000 Ω				
16					-12V DC Preamp #2	2000 Ω				
17										
18										
19										
20										
21										
22					Pick-up Pulse Out					
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Clock (J3) DBM-25P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1					No connection					
2	#22	1	T2S	15	50KHz Standard frequency (KC50A)	1730Ω		70KHz Sq Wv	0.05	6.00
3	#22	1	T2S	15	50KHz Return					
4	#22	2	T2S	17	10KHz Standard frequency (KC10A)	1730Ω		14KHz Sw Wv	0.05	6.00
5	#22	2	T2S	17	10KHz Return					
6					No Connection					
7					No Connection					
8	#22	3	T2S	21	400Hz ØA Motor Drive	275 Ω		560Hz Sw Wv	+.5	+28
9	#22	3	T2S	21	400Hz ØA Return					
10	#22	4	T2S	23	400Hz ØB Motor Drive	275 Ω		560 Hz Sq Wv	+.5	+28
11	#22	4	T2S	23	400Hz ØB Return					
12					No Connection					
13					No Connection					
14					No Connection					
15					Shield tie pin for J5N05 Pins 2 & 3					
16					No Connection					
17					Shield tie pin for J5N05 pins 4 & 5					
18					No Connection					
19					No Connection					
20					No Connection					
21					Shield tie pin for J5N05 pins 8 & 9					
22					Signal ground					
23					Shield tie pin for J5N05 pins 10 & 11					
24					Power ground					
25					Chassis ground					

NOTE 1: Over wrap entire harness with copper foil and mylar tape. Tie shield to connector.

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Command (J4) DDJ-50P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1	#22				Electronics ON Ret	30	250	40±5MS Pulse	0.5	+28
2	#22				Electronics ON				0.5	
3					Electronics OFF Ret		250			
4					Electronics OFF					
5					Motor ON Ret		125			
6					Motor ON					
7					Motor OFF Ret		125			
8					Motor OFF					
9					Motor High Power Mode Ret		250			
10					Motor High Power Mode					
11					Motor Low Pwr Mode Ret	30	250			
12					Motor Low Power Mode					
13					Cone Cover Limit Switch Override					
14					Cone Cover Limit Switch Override					
15					Cone Cover Limit Switch Override					
16					Cone Cover Limit Switch Override					
17					Cone Door Status					
18					Spare					
19					Window Heater Control					
20					Window Heater Control					
21					Patch Heater Automatic Ret	30	250			
22					Patch Htr Automatic					
23					Patch Htr Full Time Ret	30	250			
24					Patch Htr Full Time					
25					Cone Heater ON Ret	30	250			
26					Cone Heater ON					
27					Cone Heater OFF Ret	30	250			
28					Cone Heater OFF					
29					Cone Cover Deploy #1 Ret	30	250			
30	#22				Cone Cover Deploy #1			40±MS Pulse	0.5	+28

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Command (J4) DDJ-50P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
31	#22				Cone Cover Display #1 Reg	30	250	40±.5MS Pulse	0.5	+28
32					Cone Cover					
33					Cone Cover Deploy #2 Ret	30	250			
34					Cone Cover Deploy (MB 340) #2					
35					Cone Cover Close #2 Ret	30	250			
36					Cone Cover Close #2					
37					Pick-up 1 on Ret	30	250			
38					Pick-up 1 on					
39					Select 8μ Data (MA014) Pickup 2 on Ret	30	250			
40					Select 8μ (MB400) Pickup 2 on					
41					Purge On Valve Open Ret	30	250			
42					Purge Valve Open					
43					Purge Valve Close Ret	30	250			
44					Purge Valve Close					
45					Scan Motor Heat Control Thermostat Side					
46					Scan Motor Thermostat Bypass					
47					Scan Motor Heat Control					
48					Signal Ground					
49					Power Ground +280VDC Return					
50	#22				Chassis Ground			40±.5MS Pulse	0.5	+.28

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Analog Telemetry (J5) DBJ-25P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1	#24				Electronics Temp	3320Ω	>10^6Ω	Analog Volt	0	5.0
2					Cone Temperature					
3					Baseplate Temperature					
4					Blackbody Temp #1					
5					Blackbody Temp #2					
6					Patch Temperature					
7					Motor Drive Current					
8					+15 Volt Monitor					
9					-15 Volt Monitor					
10					+5 Volt Monitor					
13					Telemetry Pwr Monitor					
14					Cone Cover Position Monitor					
15					Patch Voltage					
16					Cone Wall Housing Temp					
17					Purge Pressure					
18					Electronics Current	3320Ω	>10^6Ω	Analog Volt	0	5.0
19					Signal Ground					
20					Signal Ground					
21					Motor Hsg Temp	3320Ω	10^6Ω	Analog Volt	0	5.0
22					Power Ground					
23					Offset Voltage	3320Ω	10^6Ω	Analog Volt	0	5.0
24					Mon. Comp. Sp. Telm.					
25					Scan Mon. Spd Telm.					

NOTE 1: Over wrap entire harness with mylar and copper tape. Tie shield to connector.

NOTE 2: On P5N11 Tie Pins 19, 20 and 21 together with std. shorting bar.

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Power (16) DEJ-9P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1	20	1	T2		+28.0 Volt Reg Bus	>.1		DC Power	27.4	+28.6
2	20	2	T2		+28.0 Volt Reg Bus	>.1		DC Power	27.4	+28.6
3	16	1	T2		Reg Bus Return			DC Return	27.4	+28.6
4	16	2	T2		Reg Bus Return			DC Return	27.4	+28.6
5					Spare					
6					Spare					
7					Spare					
8					Signal Ground					
9					Chassis Ground					

TABLE 7-1

SIGNAL CHARACTERISTICS TABLE

Digital Telemetry (17) DAJ-15P-NMB-1-A106

PIN NO.	WIRE SIZE	TWIST GROUP	WIRE TYPE	SHIELD TIE PIN	FUNCTION	IMPEDANCE Source	IMPEDANCE Load	Signal Type	VOLTAGE RANGE Min	VOLTAGE RANGE Max
1	#22				Electronics ON/OFF Monitor	<15K	>10^6	Bi level	0.8	10.0
2	#22				Motor ON/OFF Monitor	<51K	>10^6	Bi level	0.8	10.0
6	#22				Patch Heater Full Time/Auto. Monitor	<51K	>10^6	Bi level	0.8	10.0
7	#22				Cone Heater ON/OFF Monitor	<51K	>10^6	Bi level	0.8	10.0
8	#22				Cone Cover Enable Deploy/Close	<51K	>10^6	Bi level	0.8	10.0
9	#22				Cone Cover Deploy/ Close	<51K	>10^6	Bi level	0.8	10.0
10	#22				Pickup Status	<51K	>10^6	Bi level	0.8	10.0
11	#22				Purge ON/OFF	<51K	>10^6	Bi level	0.8	10.0
12					Spare					
13					Signal Ground					
14					Power Ground					
15					Chassis Ground					

8.0 ANALOG TELEMETRY

The Analog Telemetry Equations for HCMR are listed on the following pages. The values from which the curves were determined are listed below the telemetry equations. Telemetry curves of the listed values are also included in this section.

ANALOG TELEMETRY EQUATIONS FOR HCMR

Patch Temperature

$$T_K = 105.68 + 6.2055E$$

E_{TM}(volts)	Temperature K
1.00000E-05	105.76
1.211	113.2
2.033	118.2
2.833	123.2
5	136.78

Elect. Temperature
Baseplate Temperature
BB #1 Temperature
BB #2 Temperature

$$T_C = 56.5833 - 10.8473E$$

$$T_C = 59.7317 - 15.556E + 1.772E^2 - 0.1917E^3$$

E_{TM}(volts)	Temperature $^{\circ}C$
.6739	50
1.4759	40
2.3974	30
3.3785	20
4.333	10
5	2.29

Cone Wall Temperature

$$T_K = 143.641 + 30.8831E$$

E_{TM}(volts)	Temperature $^{\circ}K$
.2889	153.2
1.6199	193.2
2.922	233.2
5	298.57

Preamp Power

+V changes

$$V = 1.6653E_{TM} + 7.401$$

E_{TM}(volts)	Preamp Power(volts)
0	7.401
5	15.728

-V changes

$$V = 16.4828 - 2.503E_{TM}$$

E_{TM}(volts)	Preamp Power(volts)
0	16.48
5	3.97

Offset Bias

$$V_{Bias} = 2E_{TM} - 14.329$$

E_{TM}(volts)	Offset Bias(volts)
0	-14.329
5	-4.329

Purge Pressure

$$\text{Purge Pressure (PSIG)} = 100 - 29.5E_{TM}$$

E_{TM}(volts)	Purge Pressure(PSIG)
0	100
3.39	0

+5V TM

$$V = 2E_{TM}$$

E_{TM}(volts)	+5V TM(volts)
0	0
5	10

+15V TM

$$V = 4.425E_{TM}$$

E_{TM} (volts)	+15 TM (volts)
0	0
5	22.12

Telemetry Power TM

$$V = 4.425E_{TM}$$

E_{TM} (volts)	Telemetry Power (volts)
0	0
5	22.12

-15V TM

$$V = 5.006E_{TM} - 23.8864$$

E_{TM} (volts)	-15V TM (volts)
0	-23.89
5	+1.144

Compensating Motor Speed

$$RPM = \frac{840000}{144 + 50.82E_{TM}}$$

E_{TM} (volts)	Comp. Motor Speed (RPM)
0	5833
5	2110

Scan Motor Speed

$$RPM = \frac{840000}{976 + 51.06E_{TM}}$$

E_{TM} (volts)	Scan Motor Speed (RPM)
0	860
5	682

Cooler Hsg Temperature

$$T_C = 103.844 - 62.7415E + 17.2109E^2 - 2.622E^3 + .1323E^4$$

E_{TM}(volts)	Temperature °C
5.01	-25
4.78	-20
4.524	-15
4.246	-10
3.959	-5
3.644	0
3.333	5
3.025	10
2.726	15
2.441	20
2.176	25
1.929	30
1.705	35
1.503	40
1.323	45
1.163	50
1.022	55
.898	60

Electronic Current

$$I_{amps} = \frac{E_{TM}}{4.2}$$

E_{TM}(volts)	Elect. Current I(amps)
0	0
5	1.19

Motor Current

$$I_{amps} = \frac{E_{TM}}{3.7}$$

E_{TM}(volts)	Motor Current (amps)
0	0
5	1.35

Cone Cover Position

$$CCP(\text{degrees}) = 22.73E_{TM} - 4.92$$

E_{TM}(volts)	Cone Cover Position(degrees)
.21	0
4.88	106

Patch Power

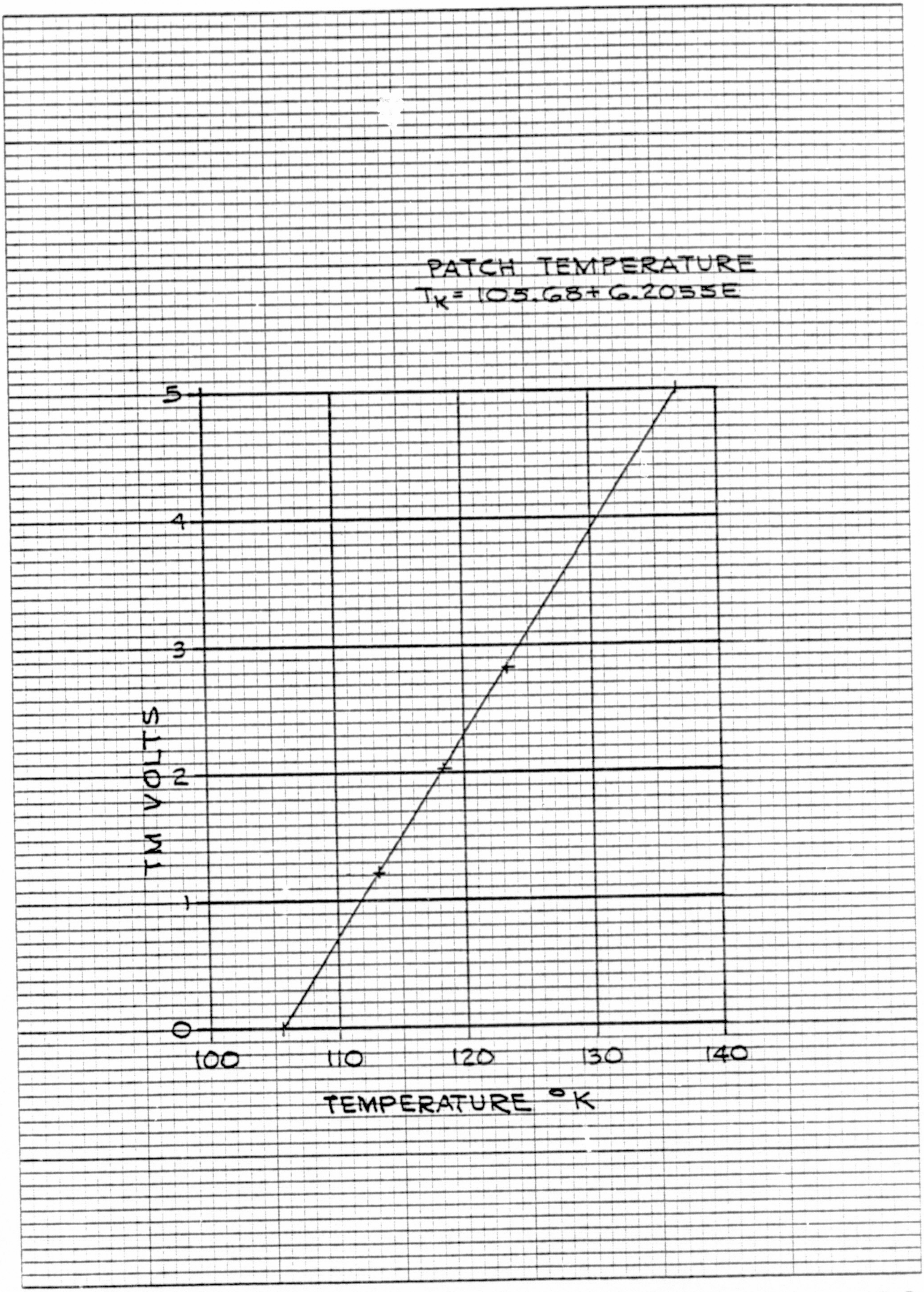
$$P_p = \frac{E_{TM}^2}{3000}$$

E_{TM}(volts)	Patch Power(watts)
0	0
1	$.333 \times 10^{-3}$
2	1.33×10^{-3}
3	3.0×10^{-3}
4	5.33×10^{-3}
5	8.33×10^{-3}

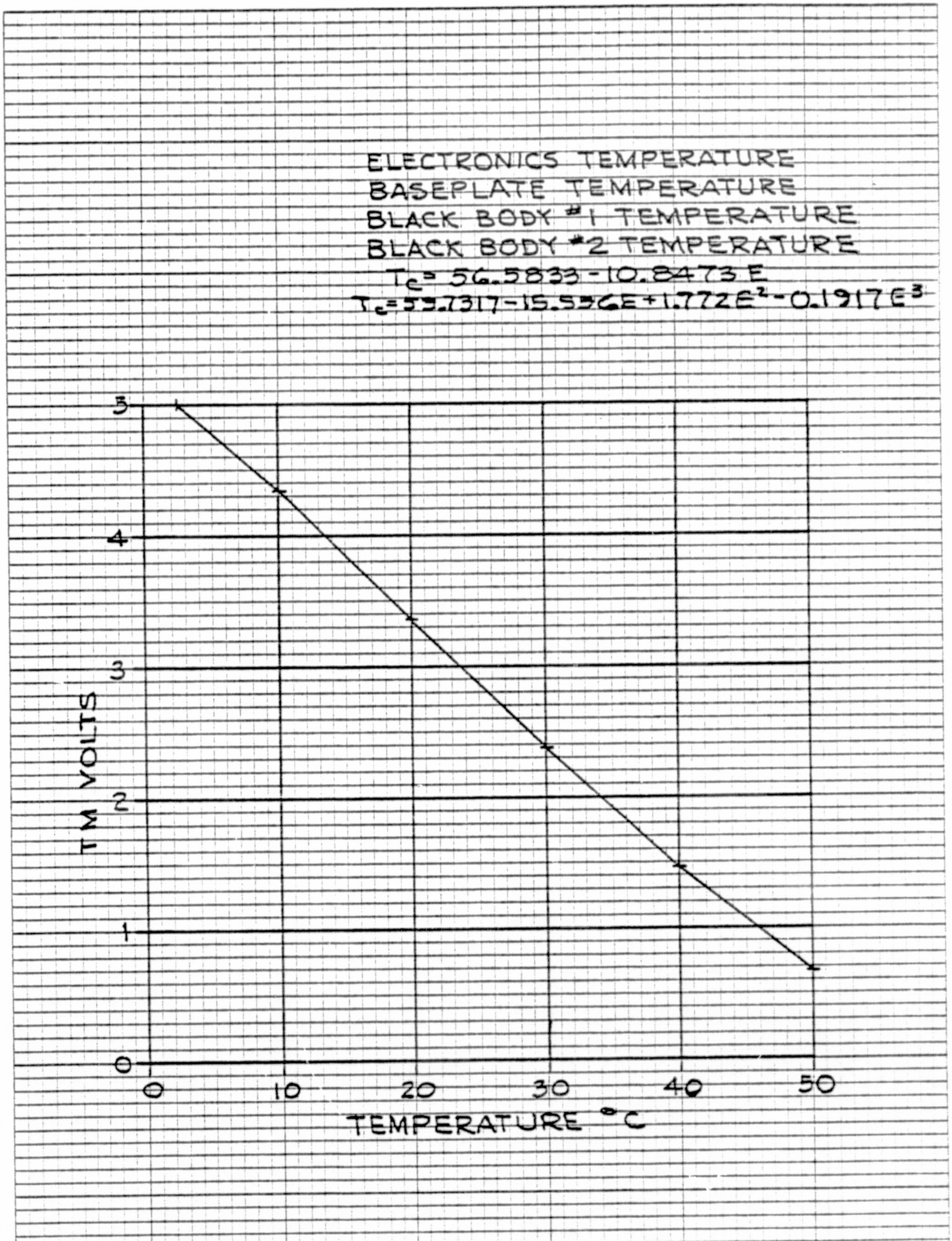
Motor Hsg Temperature TM

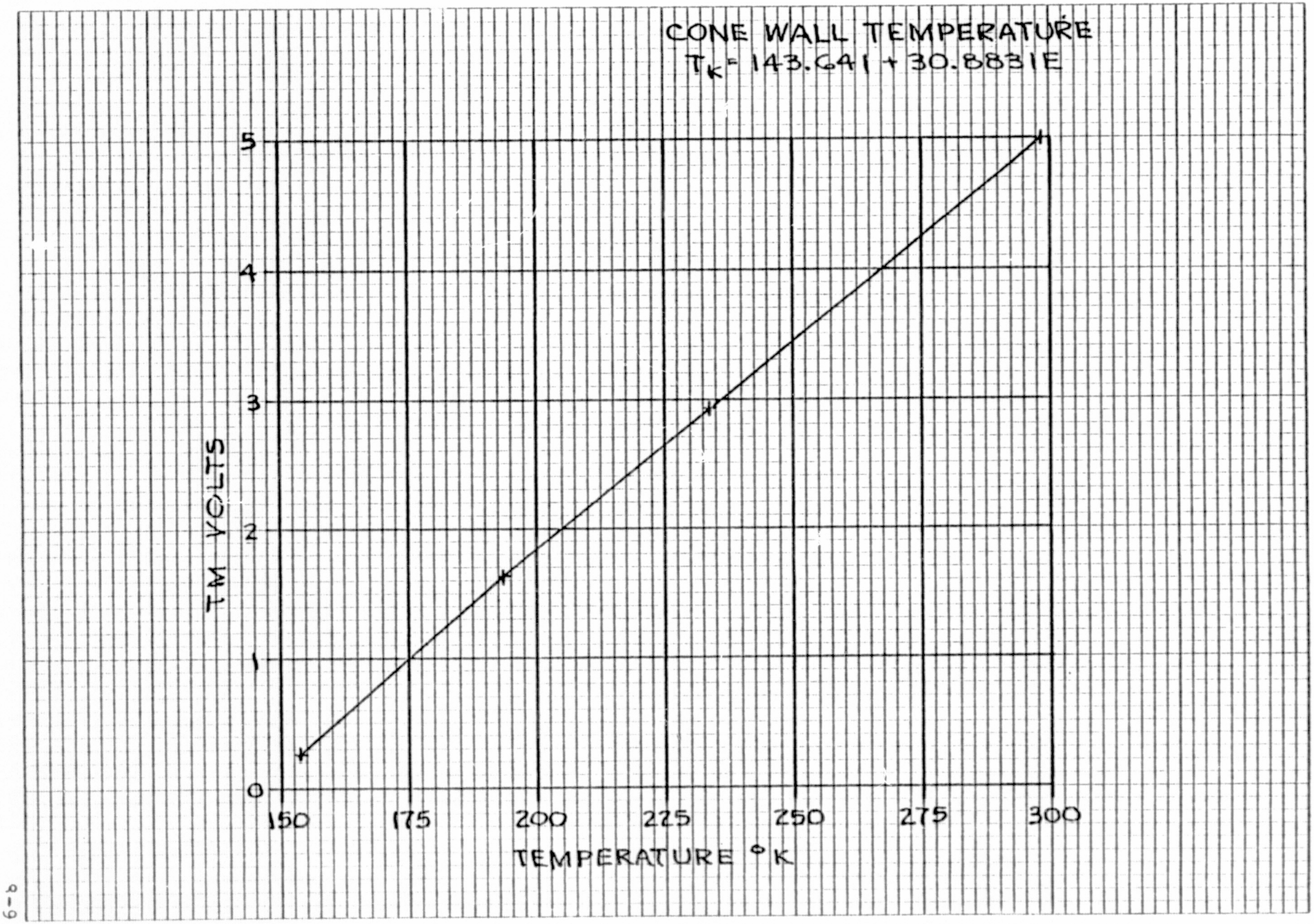
$$T_c = 48.80 - 12.60E + 1.25E^2 - .174E^3$$

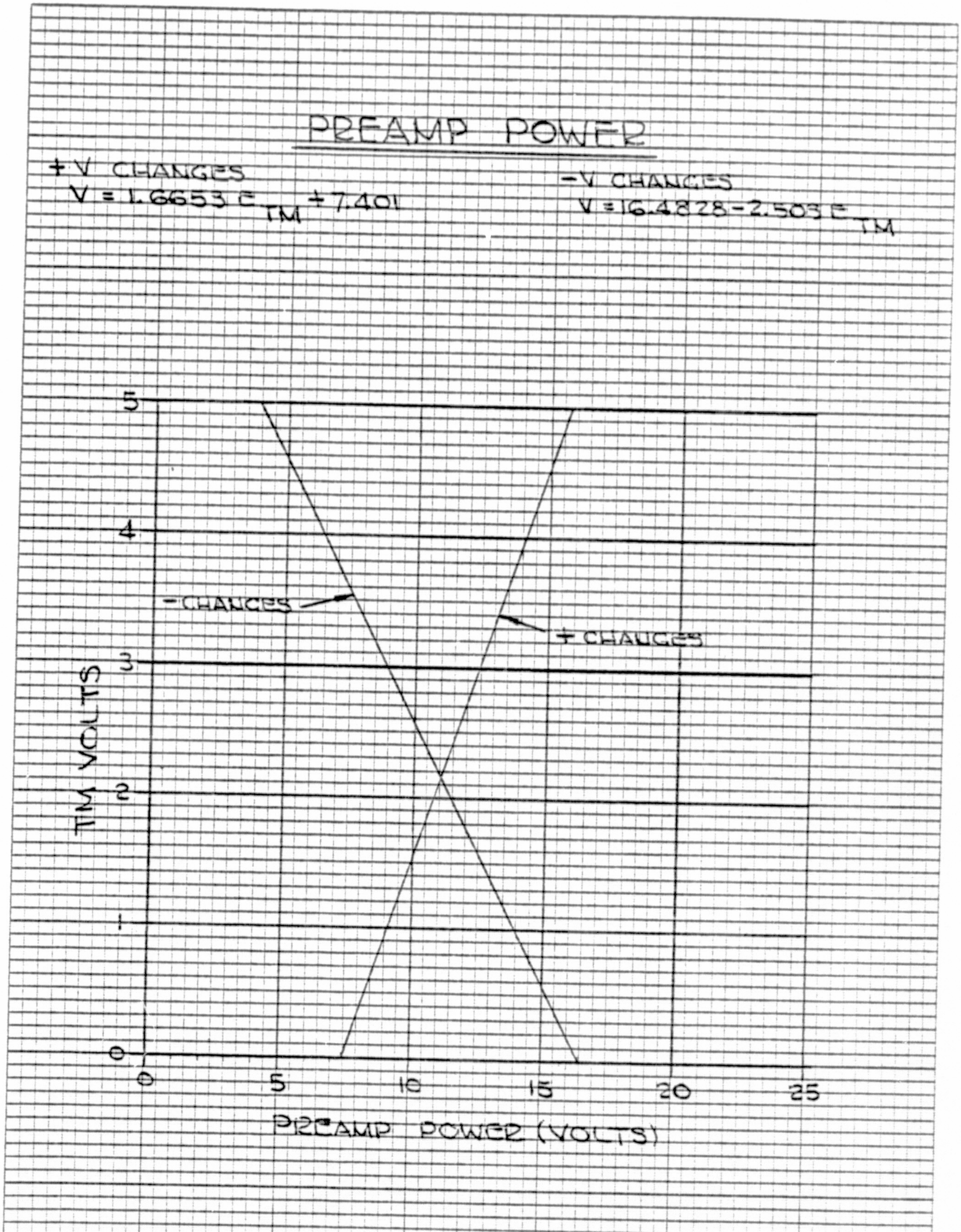
E_{TM}(volts)	Temperature ($^\circ$C)
0	48.8
.748	40
1.715	30
2.744	20
3.745	10
4.627	0
5.0	-4.94



PATCH TEMPERATURE
T_K = 105.68 + 6.2055E
TM VOLTS
0
1
2
3
4
5
100
110
120
130
140
TEMPERATURE °K


ELECTRONICS TEMPERATURE
BASEPLATE TEMPERATURE
BLACK BODY #1 TEMPERATURE
BLACK BODY #2 TEMPERATURE
Tc= 56.5833-10.8473 E
Tc=59.7317-15.556E+1.772E²-0.1917E³
TM VOLTS
TEMPERATURE °C
0
1
2
3
4
5
0
10
20
30
40
50


CONE WALL TEMPERATURE
$T_K = 143.641 + 30.8831E$
TM VOLTS
0
1
2
3
4
5
150
175
200
225
250
275
300
TEMPERATURE °K



46 0703

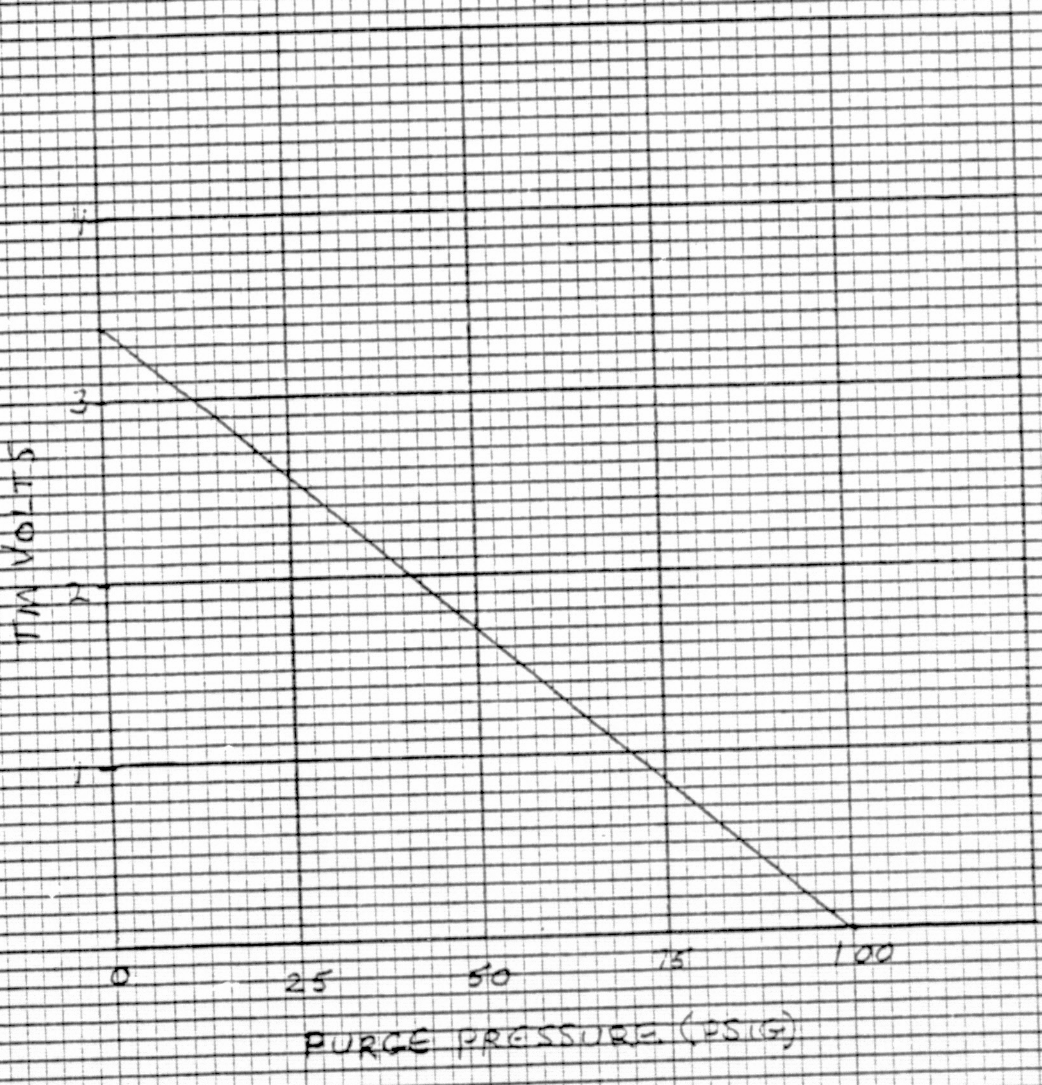
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

OFFSET BIAS

$V_{BIAS} = 2E_{TM} - 14.329$

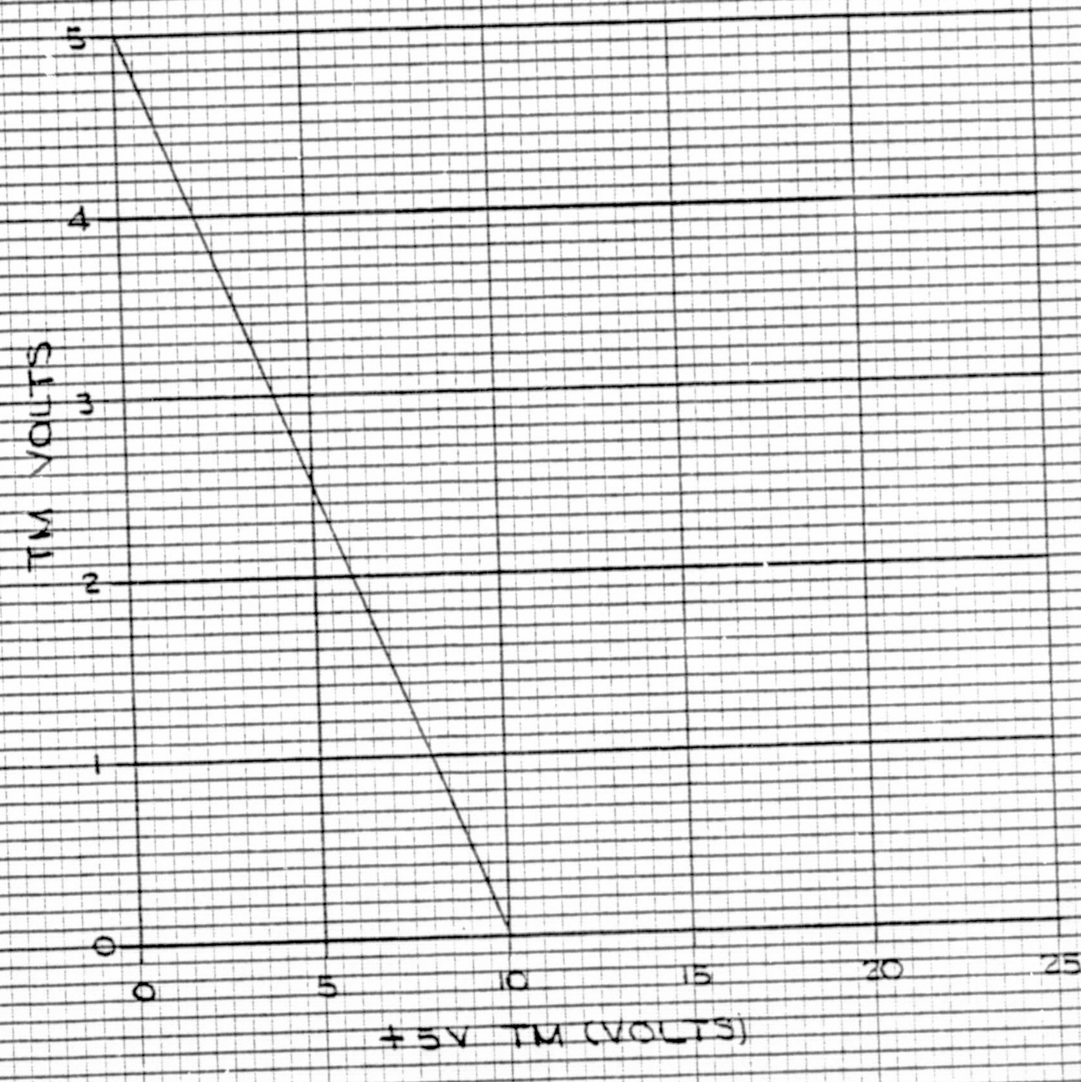
PURGE PRESSURE

PURGE PRESSURE (PSIG) = $100 - 29.5\ E_{TM}$

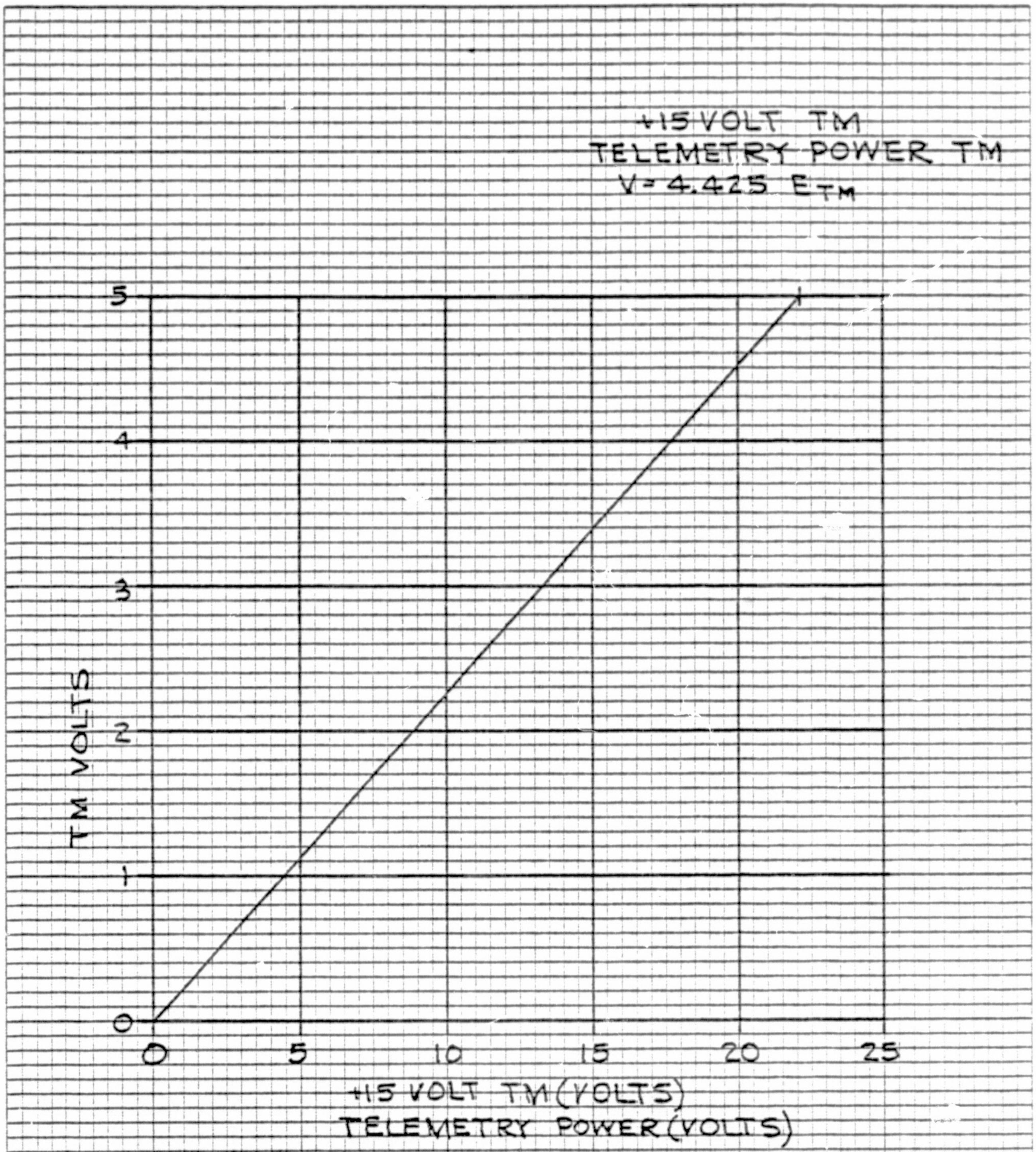


+5V TM

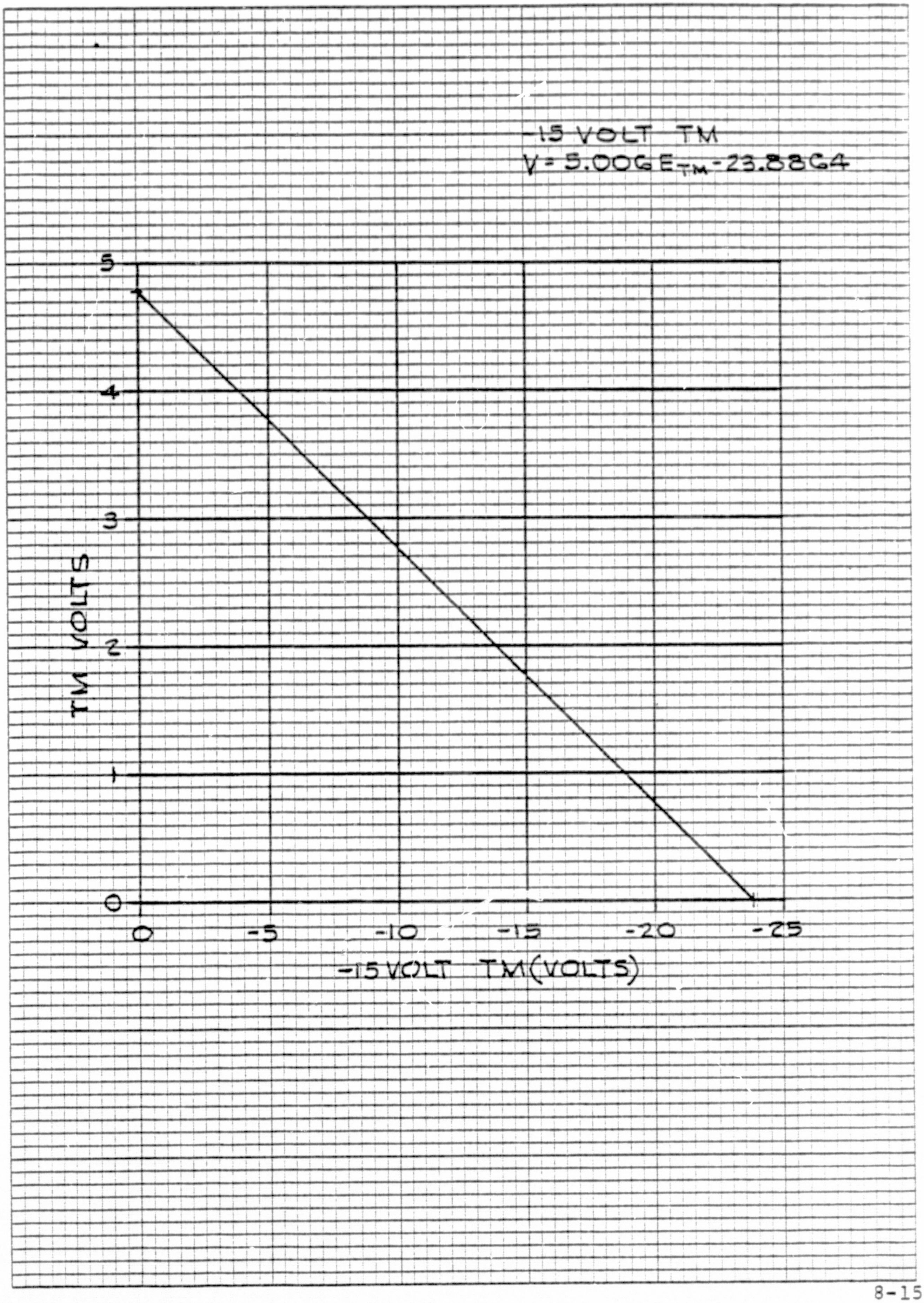
$V = 2E_{TM}$

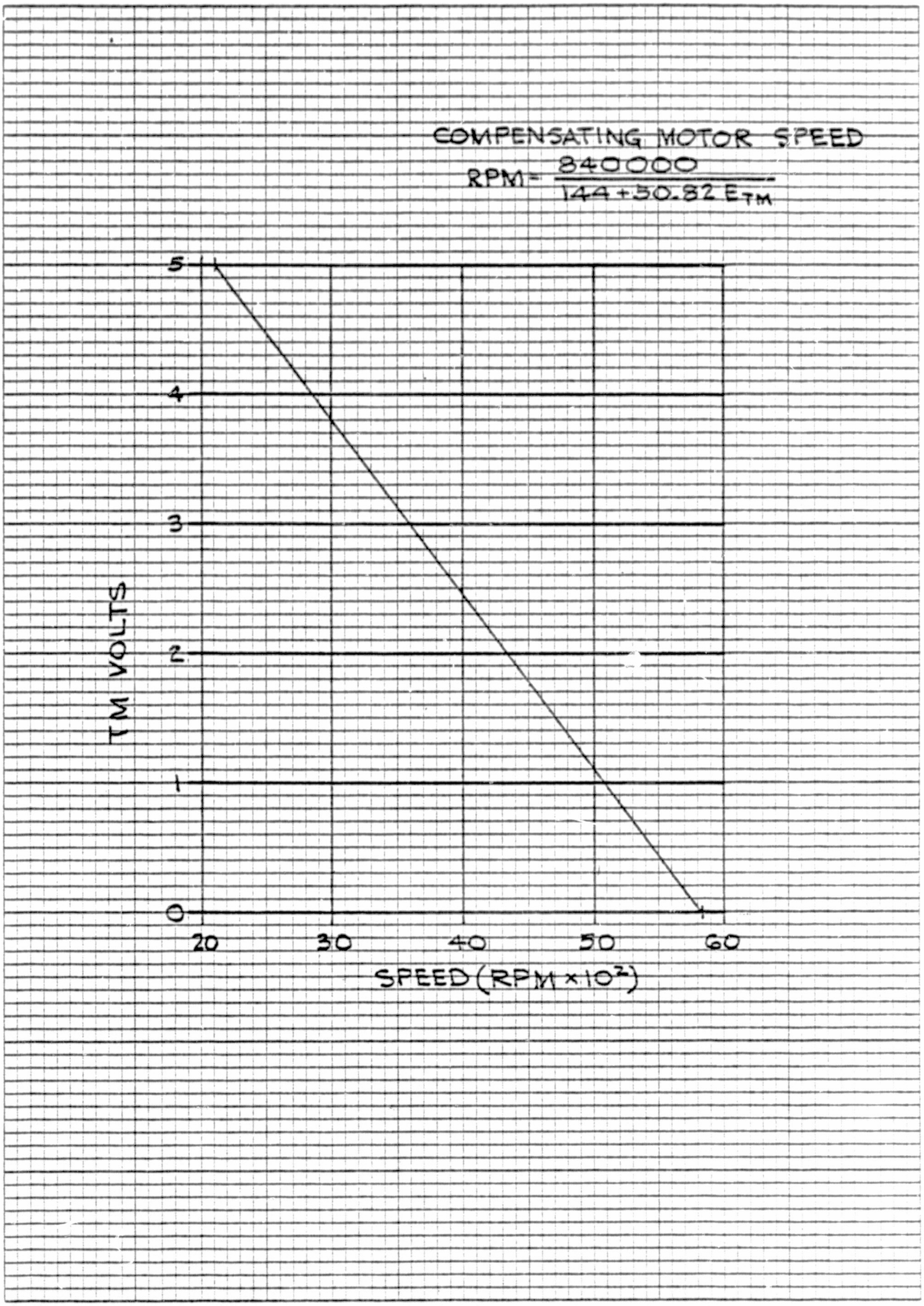


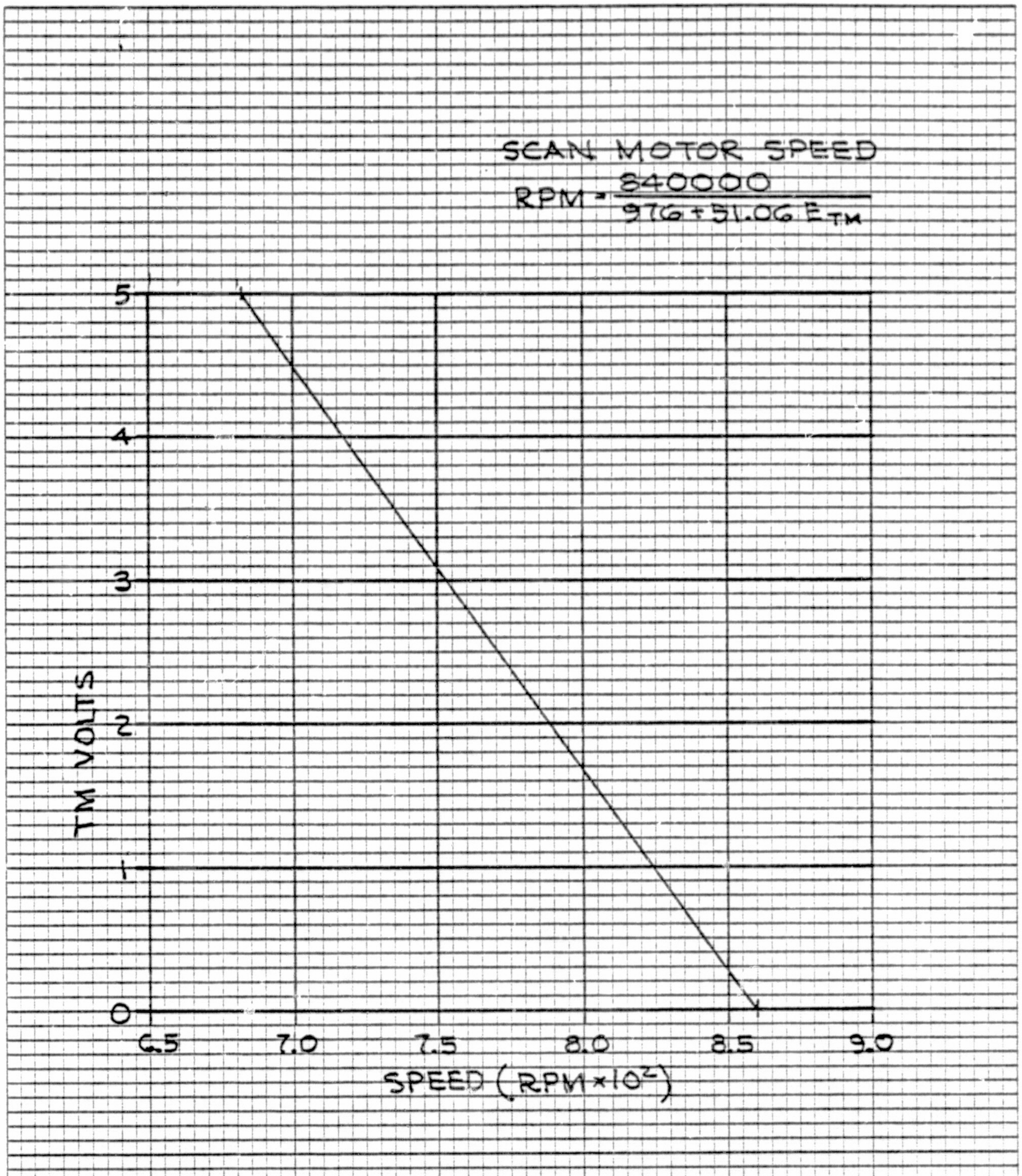
K&E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0703



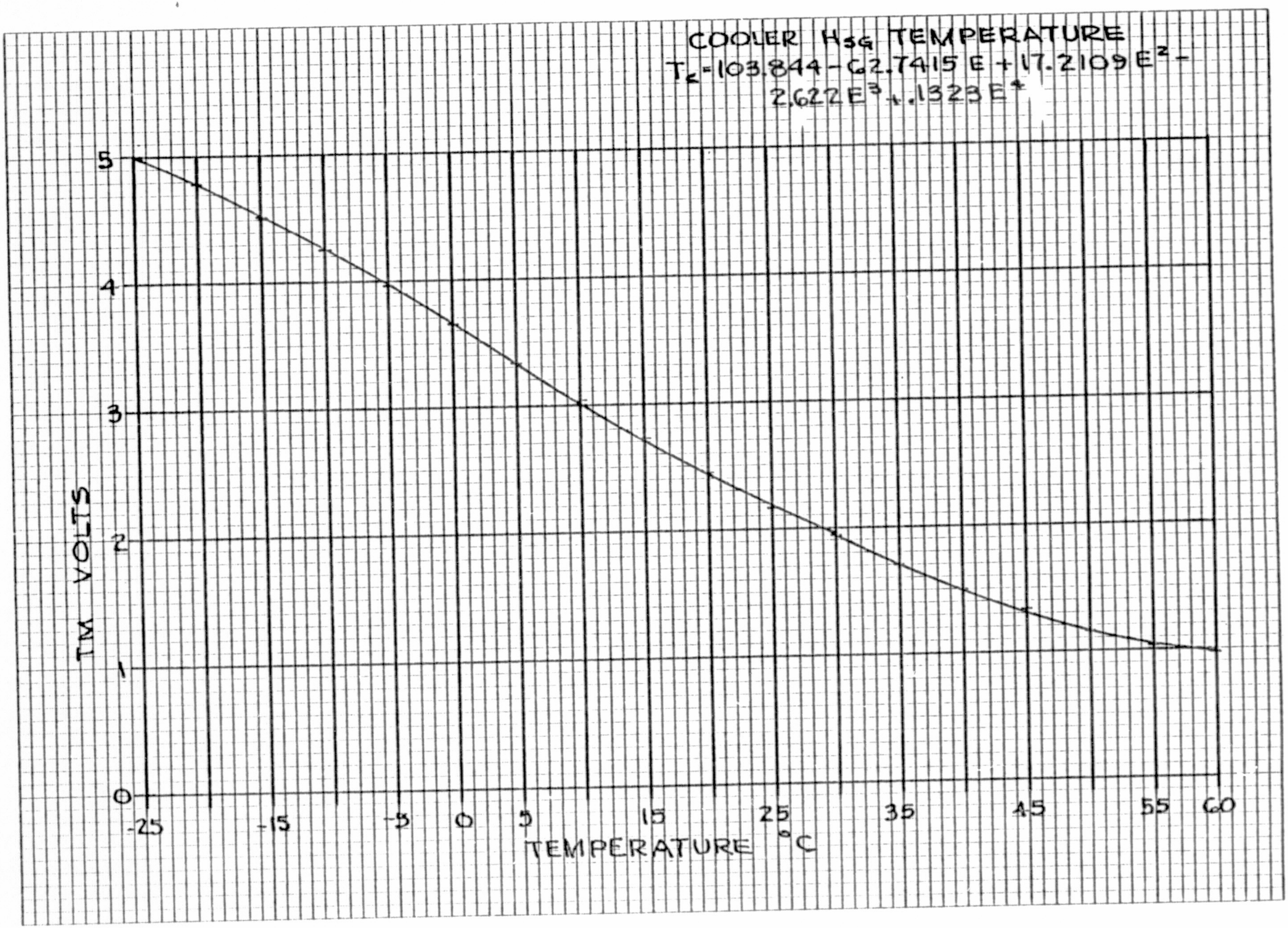
+15 VOLT TM
TELEMETRY POWER TM
V = 4.425 E_{TM}
TM VOLTS
0
1
2
3
4
5
0
5
10
15
20
25
+15 VOLT TM (VOLTS)
TELEMETRY POWER (VOLTS)


-15 VOLT TM
V = 5.006 E$_{TM}$ - 23.8864
TM VOLTS
5
4
3
2
1
0
0
-5
-10
-15
-20
-25
-15 VOLT TM (VOLTS)


COMPENSATING MOTOR SPEED
RPM = 840000 / 144+50.82 E_TM
TM VOLTS
0
1
2
3
4
5
20
30
40
50
60
SPEED (RPM × 10²)

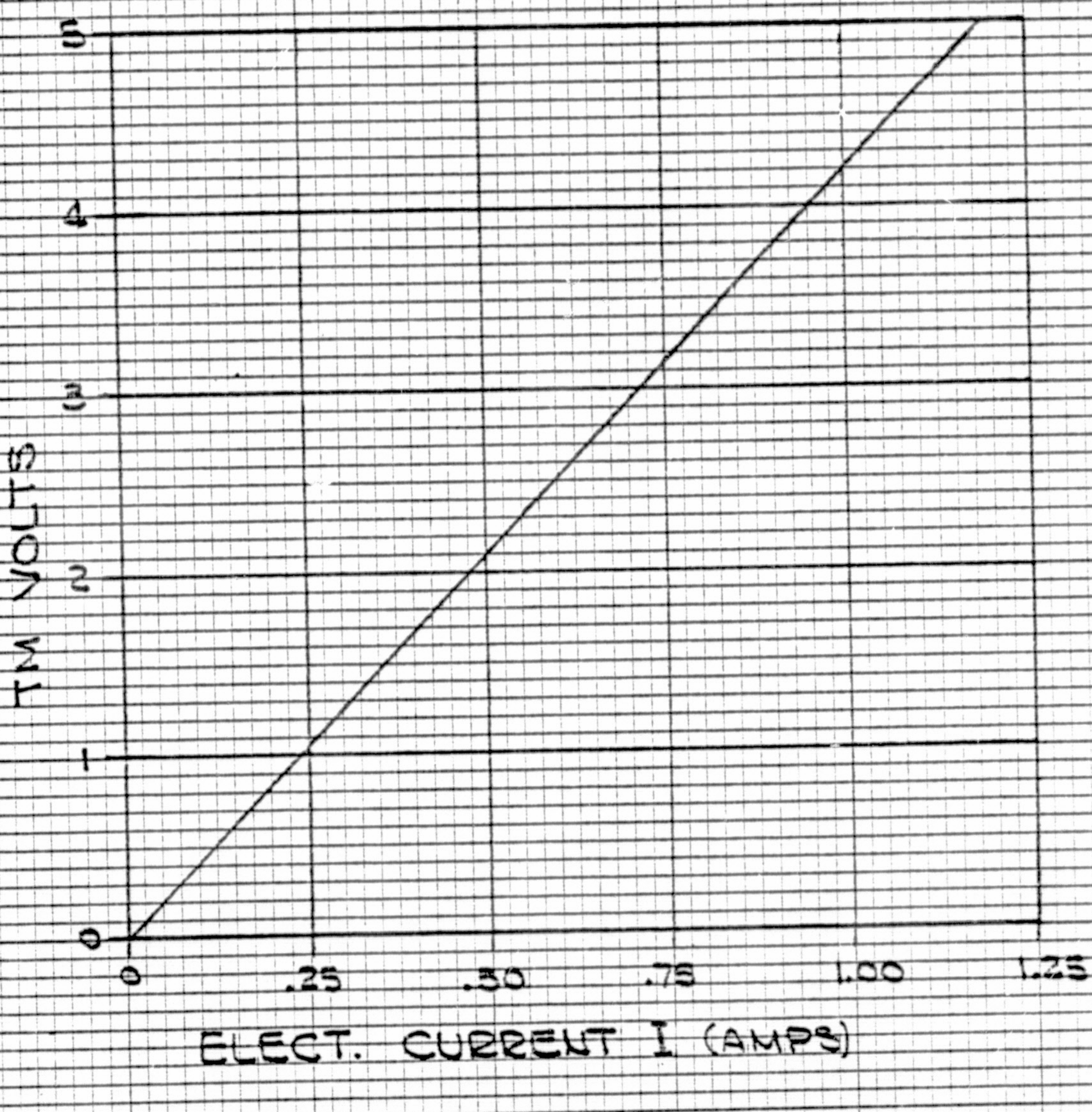


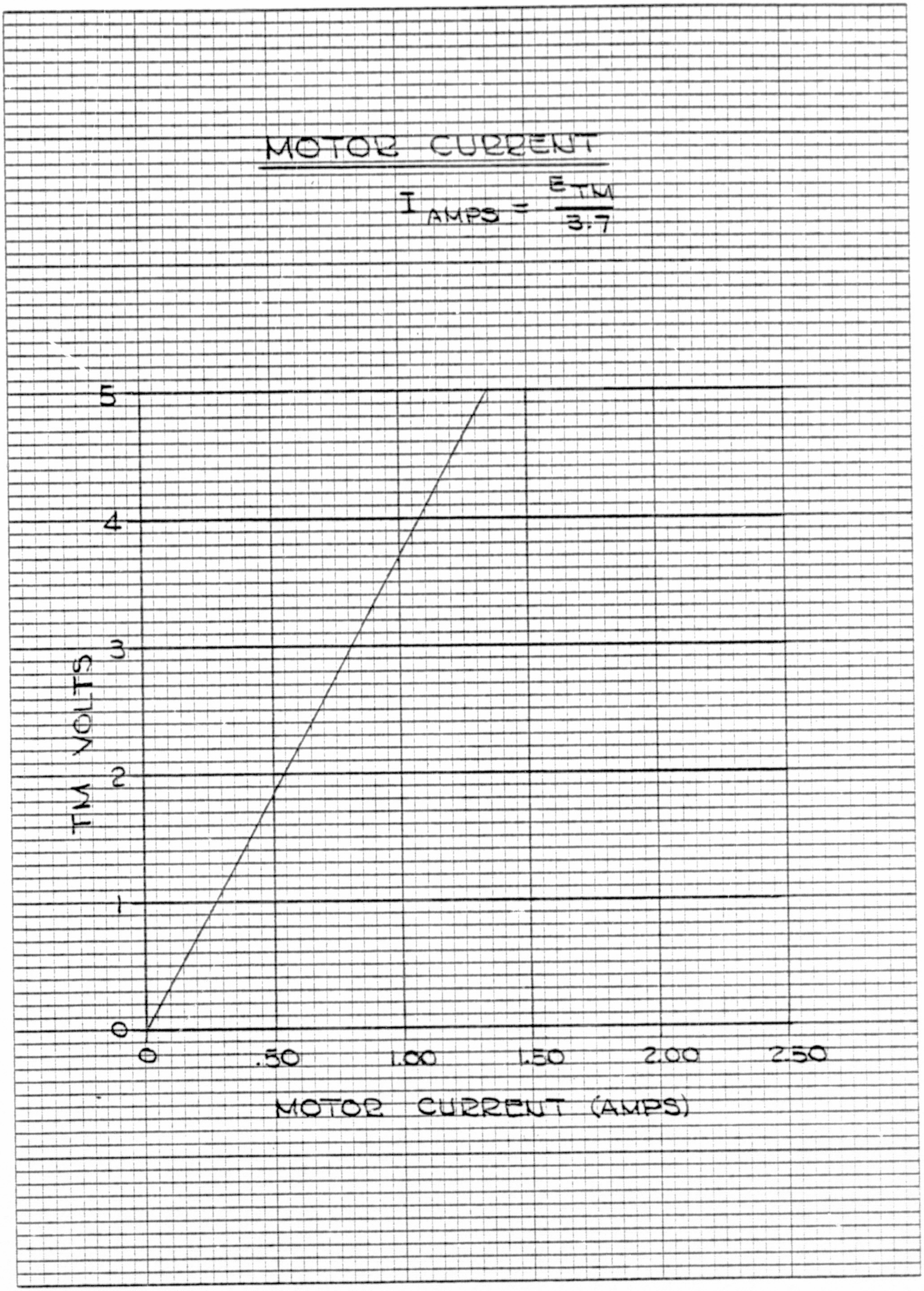
SCAN MOTOR SPEED
RPM = 840000 / 976+51.06 E TM
TM VOLTS
0
1
2
3
4
5
6.5
7.0
7.5
8.0
8.5
9.0
SPEED (RPM×10²)


COOLER HSG TEMPERATURE
T_c = 103.844 - 62.7415 E + 17.2109 E² - 2.622 E³ + .1323 E⁴
TM VOLTS
5
4
3
2
1
0
-25
-15
-5
0
5
15
25
35
45
55
60
TEMPERATURE °C

ELECTRONIC CURRENT

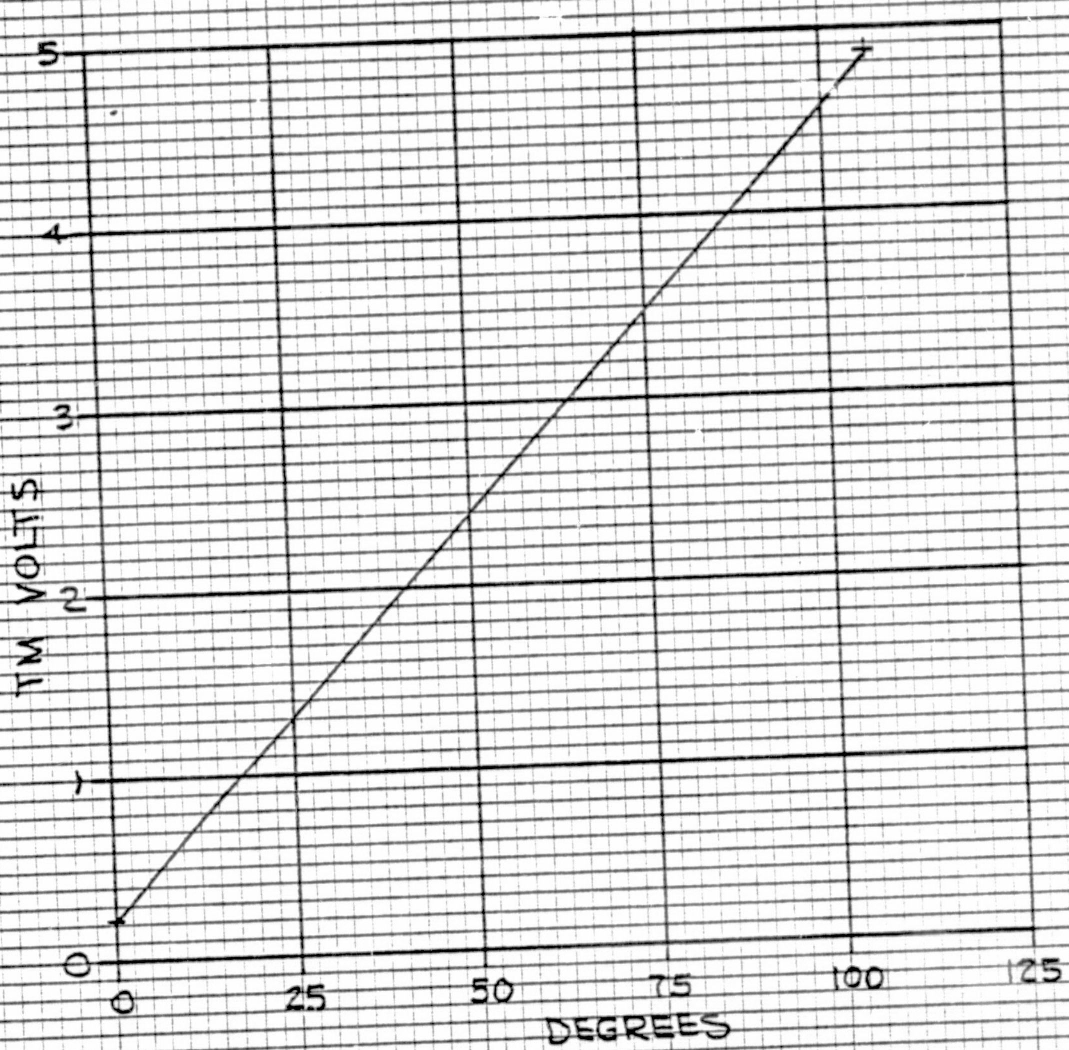
$$I_{AMPS} = \frac{E_{TM}}{4.2}$$

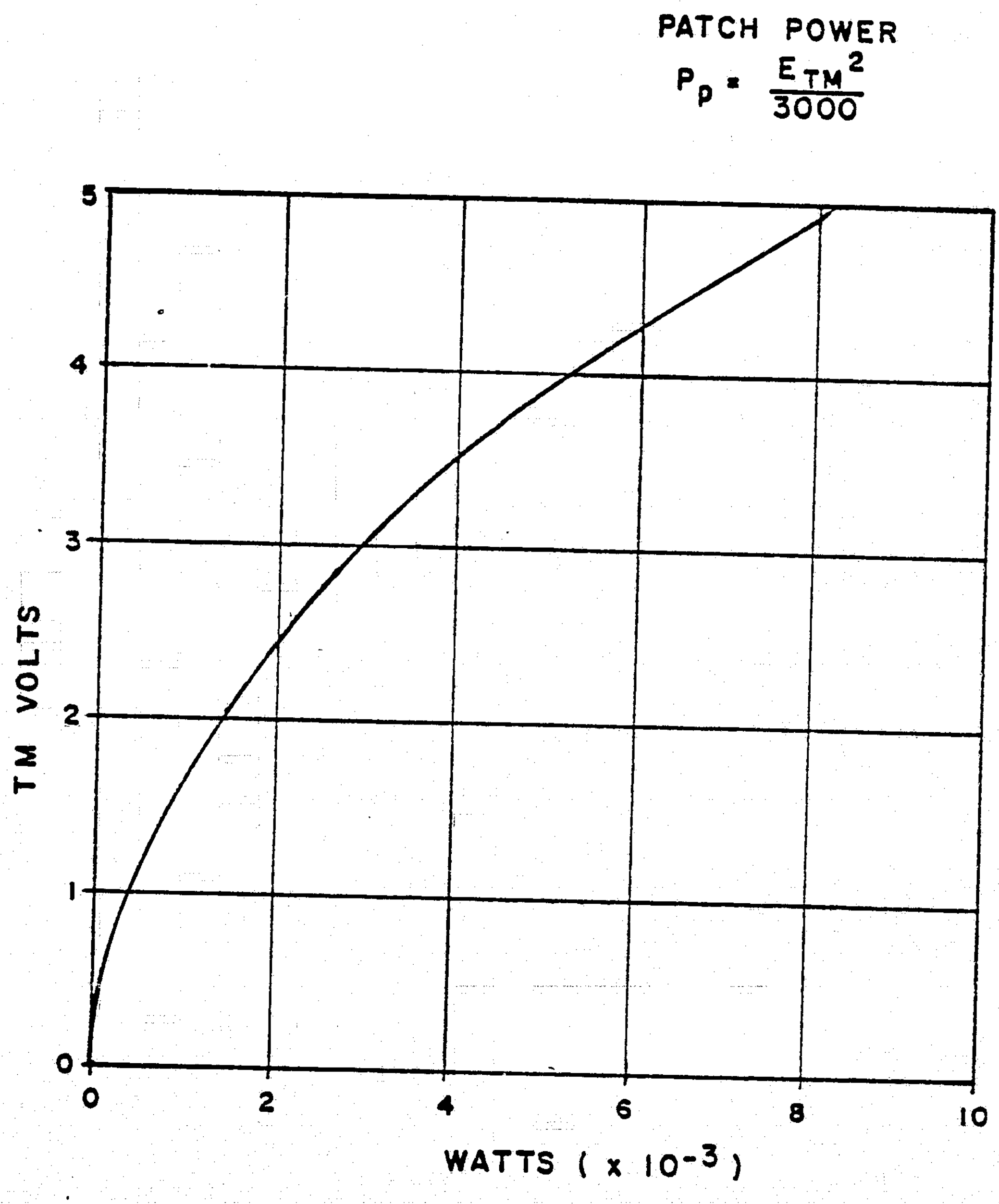



MOTOR CURRENT
$I_{AMPS} = \frac{E_{TM}}{3.7}$
TM VOLTS
5
4
3
2
1
0
0
.50
1.00
1.50
2.00
2.50
MOTOR CURRENT (AMPS)

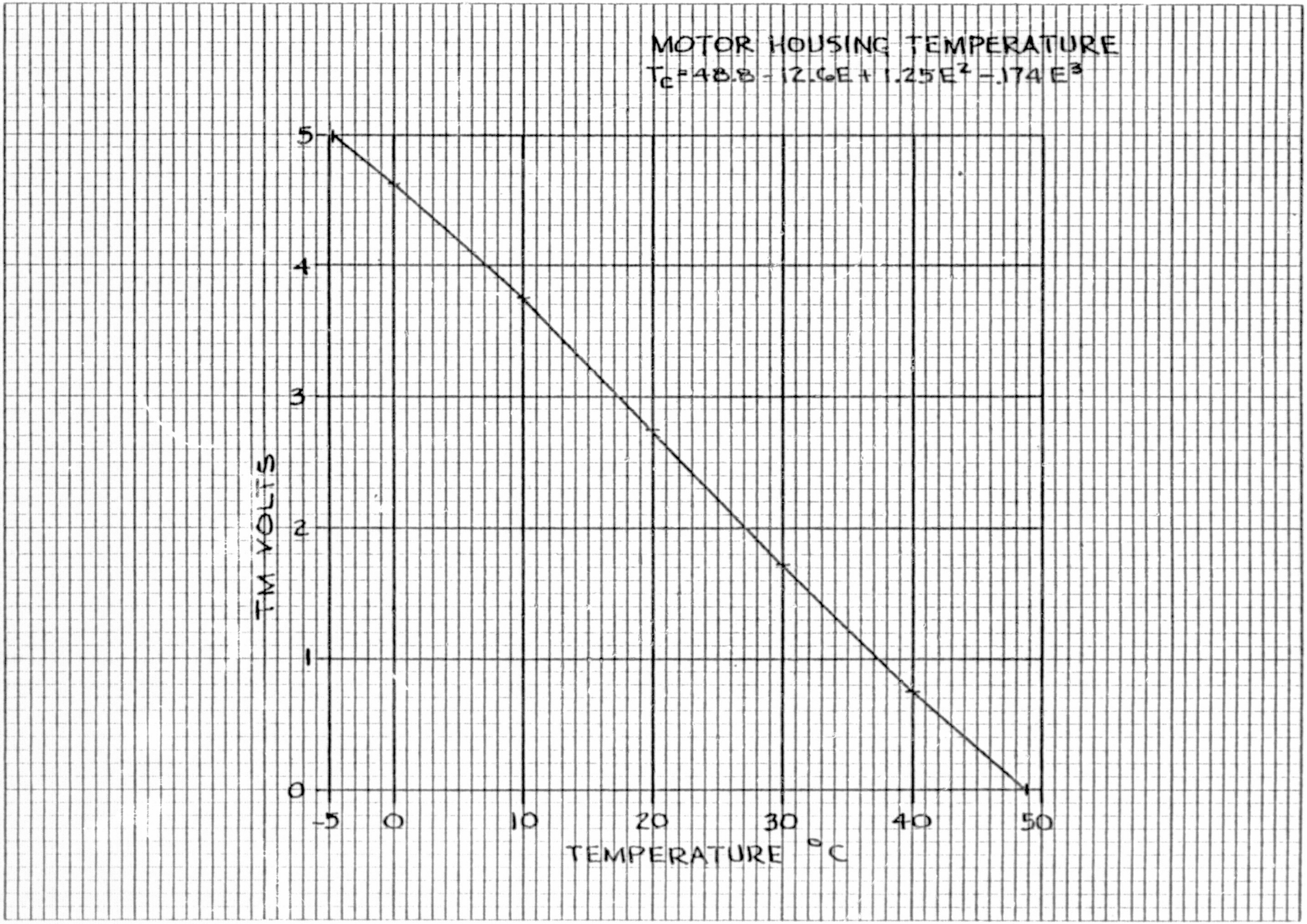
CONE COVER POSITION

$CCP^{\circ} = 22.73E_{TM} - 4.92$





PATCH POWER
$P_p = \frac{E_{TM}^2}{3000}$
TM VOLTS
0
1
2
3
4
5
0
2
4
6
8
10
WATTS (x 10^{-3})


MOTOR HOUSING TEMPERATURE
$T_c = 48.8 - 12.6E + 1.25E^2 - .174E^3$
TM VOLTS
0
1
2
3
4
5
-5
0
10
20
30
40
50
TEMPERATURE °C

9.0 HCMR CALIBRATION DATA

The measured values of NEΔT in the IR channel and S/N ratio in the near IR channel at various baseplate temperatures are listed in Table 9-1.

Table 9-2 contains the measured values of the HCMR calibration steps with different instrument baseplate temperatures.

Table 9-3 is the analog telemetry data vs instrument baseplate temperature.

The IR Analog Calibration data vs baseplate temperature is listed in Table 9-4. The table shows the IR signal output volts for set IR calibration blackbody temperature. The (Avg cal Tgt temp.) is the average of the seven temperature read-outs on the Calibration blackbody. The information is again given for various instrument baseplate temperatures. Figure 9 - 1 is the HCMR IR video output vs scene temperature for different values of baseplate temperature.

These curves were constructed from computed best fit equations for the data listed in Table 9-4. The coefficients of the equations and the data from which they are derived are listed on the following pages.

BASEPLATE 0°C

```
RUN
INPUT # OFDATA POINTS
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 Ø     DEGREE COEFFICIENT         = 257.997
 1     DEGREE COEFFICIENT         = 18.4691
 2     DEGREE COEFFICIENT         =-.942917
 3     DEGREE COEFFICIENT         =-4.37050E-02
 4     DEGREE COEFFICIENT         = 1.07279E-02

X-ACTUAL        Y-ACTUAL        Y-CALC          PCT DIFFER
 .124            260.18          260.272            Ø
 .6753           270.19          270.028            Ø
 1.3337          280.95          280.882            Ø
 1.9482          290.1           290.231            Ø
 2.6792          300.24          300.423            Ø
 3.4368          310.14          310.057            Ø
 4.2723          320.18          319.858             .1
 5.1583          329.46          329.774            Ø
 6.0704          340.24          340.157            Ø

READY
```

BASEPLATE +5°C

```
RUN
INPUT # OFDATA POINTS
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 Ø     DEGREE COEFFICIENT         = 258.019
 1     DEGREE COEFFICIENT         = 19.6024
 2     DEGREE COEFFICIENT         =-1.9052
 3     DEGREE COEFFICIENT         = .227264
 4     DEGREE COEFFICIENT         =-1.25476E-02

X-ACTUAL        Y-ACTUAL        Y-CALC          PCT DIFFER
 .1009           260             259.978            Ø
 .6534           270.03          270.075            Ø
 1.262           280.16          280.148            Ø
 1.9264          290.17          290.163            Ø
 2.7063          300.97          300.947            Ø
 3.4172          310.1           310.114            Ø
 4.2357          320.07          320.099            Ø
 5.1025          330.15          330.123            Ø
 6.0255          340.13          340.139            Ø

READY
```

```
RUN                                                    BASEPLATE +10°C
INPUT # OFDATA POINTS
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0    DEGREE COEFFICIENT        = 258.263
 1    DEGREE COEFFICIENT        = 19.7513
 2    DEGREE COEFFICIENT        =-1.97098
 3    DEGREE COEFFICIENT        = .242068
 4    DEGREE COEFFICIENT        =-1.37652E-02

X-ACTUAL         Y-ACTUAL        Y-CALC          PCT DIFFER
 9.64000E-02      260.15         260.149             0
 .639             270.14         270.14              0
 1.2477           280.29         280.275             0
 1.9019           290.15         290.184             0
 2.6214           300.2          300.205             0
 3.3774           310.07         310.023             0
 4.2054           320.14         320.166             0
 5.0684           330.17         330.172             0
 5.981            340.07         340.065             0

READY
```

```
RUN
INPUT # OFDATA POINTS                                  BASEPLATE +15°C
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0    DEGREE COEFFICIENT        = 256.479
 1    DEGREE COEFFICIENT        = 19.6741
 2    DEGREE COEFFICIENT        =-1.91159
 3    DEGREE COEFFICIENT        = .228179
 4    DEGREE COEFFICIENT        =-1.26373E-02

X-ACTUAL         Y-ACTUAL        Y-CALC          PCT DIFFER
 8.79000E-02      260.17         260.193             0
 .6246            270.13         270.075             0
 1.2286           280.14         280.159             0
 1.8904           290.18         290.219             0
 2.5855           299.98         299.946             0
 3.3657           310.1          310.119             0
 4.1778           320.12         320.097             0
 5.0442           330.17         330.184             0
 5.9459           340.05         340.047             0

READY
```

BASEPLATE +20°C

```
RUN
INPUT # OFDATA POINTS
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT          = 258.794
 1     DEGREE COEFFICIENT          = 19.6036
 2     DEGREE COEFFICIENT          =-1.82114
 3     DEGREE COEFFICIENT          = .202648
 4     DEGREE COEFFICIENT          =-1.04669E-02

X-ACTUAL        Y-ACTUAL       Y-CALC         PCT DIFFER
 6.75000E-02     260.1          260.109           0
 .6085           270.12         270.093           0
 1.2168          280.27         280.294           0
 1.864           290.19         290.194           0
 2.5721          300.16         300.159           0
 3.328           310.08         310.05            0
 4.1601          320.25         320.285           0
 5.008           330.18         330.164           0
 5.9116          340.12         340.122           0

READY
```

BASEPLATE +25°C

```
RUN
INPUT # OFDATA POINTS
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT          = 259.081
 1     DEGREE COEFFICIENT          = 19.7079
 2     DEGREE COEFFICIENT          =-1.89414
 3     DEGREE COEFFICIENT          = .223598
 4     DEGREE COEFFICIENT          =-1.23276E-02

X-ACTUAL        Y-ACTUAL       Y-CALC         PCT DIFFER
 5.43000E-02     260.09         260.146           0
 .5926           270.3          270.14            0
 1.2008          280.25         280.377           0
 1.8438          290.2          290.238           0
 2.54            300.13         300.07            0
 3.3016          310.12         310.084           0
 4.1249          320.22         320.27            0
 4.9698          330.18         330.168           0
 5.8765          340.16         340.158           0

READY
```

```
RUN
INPUT # OFDATA POINTS                                  BASEPLATE +30°C
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT           = 259.382
 1     DEGREE COEFFICIENT           = 19.6976
 2     DEGREE COEFFICIENT           =-1.8863
 3     DEGREE COEFFICIENT           = .226533
 4     DEGREE COEFFICIENT           =-1.28293E-02
```

X-ACTUAL	Y-ACTUAL	Y-CALC	PCT DIFFER
3.57000E-02	260.08	260.083	0
.5752	270.15	270.129	0
1.1762	280.26	280.284	0
1.8176	290.15	290.173	0
2.5266	300.28	300.239	0
3.269	310.07	310.064	0
4.0924	320.3	320.329	0
4.9229	330.14	330.128	0
5.8231	340.1	340.1	0

READY

```
RUN
INPUT # OFDATA POINTS                                  BASEPLATE +35°C
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT           = 259.797
 1     DEGREE COEFFICIENT           = 19.4749
 2     DEGREE COEFFICIENT           =-1.75711
 3     DEGREE COEFFICIENT           = .199049
 4     DEGREE COEFFICIENT           =-1.07760E-02
```

X-ACTUAL	Y-ACTUAL	Y-CALC	PCT DIFFER
2.29000E-02	260.25	260.242	0
.5607	270.18	270.196	0
1.1575	280.27	280.274	0
1.793	290.14	290.103	0
2.5034	300.21	300.238	0
3.2375	310	310.001	0
4.0565	320.26	320.252	0
4.8987	330.22	330.226	0
5.7887	340.16	340.162	0

READY

```
RUN
INPUT # OFDATA POINTS                                    BASEPLATE +40°C
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT          = 260.007
 1     DEGREE COEFFICIENT          = 20.0119
 2     DEGREE COEFFICIENT          =-1.98857
 3     DEGREE COEFFICIENT          = .242128
 4     DEGREE COEFFICIENT          =-1.35799E-02

X-ACTUAL          Y-ACTUAL        Y-CALC          PCT DIFFER
-6.00000E-04       259.96         259.995              0
 .5287             270.13         270.066              0
 1.1138            280.15         280.143              0
 1.7553            290.13         290.187              0
 2.4561            300.25         300.255              0
 3.1917            310.11         310.085              0
 3.9973            320.25         320.224              0
 4.8361            330.2          330.236              0
 5.7119            340.11         340.101              0

READY
```

```
RUN
INPUT # OFDATA POINTS                                    BASEPLATE +45°C
INPUT DEG OF POLY TO BE FITTED
INPUT X(I) & Y(I) VALUES
NUMBER OF GIVEN DATA POINTS = 9
DEGREE OF POLYNOMIAL        = 4
 0     DEGREE COEFFICIENT          = 260.529
 1     DEGREE COEFFICIENT          = 19.73
 2     DEGREE COEFFICIENT          =-1.78309
 3     DEGREE COEFFICIENT          = .191249
 4     DEGREE COEFFICIENT          =-9.31209E-03

X-ACTUAL          Y-ACTUAL        Y-CALC          PCT DIFFER
 3.57000E-02       261.22         261.231              0
 .5084             270.12         270.123              0
 1.0906            280.21         280.16               0
 1.7365            290.33         290.33               0
 2.4284            300.25         300.341              0
 3.1687            310.3          310.29               0
 3.95              320.28         320.161              0
 4.7803            330.03         330.127              0
 5.6535            340.15         340.126              0

READY
```

The values of the equations at various base plate temperatures for a fixed set of calibration target temperatures were calculated. This data is listed in Table 9-5 and plotted in Figure 9-1.

Figure 9-2 is a plot of the average difference between the on board calibration blackbody as determined by the blackbody temperature sensor (telemetry data) and by the IR signal output as the scan mirror scans by the on board calibration blackbody.

Table 9-6 contains the information on HCMR IFOV and channel registration at 0°, 25° and 45°C baseplate temperatures.

Table 9-7 contains the near IR calibration data taken during the HCMR acceptance testing. Figure 9-3 is a graph of the near IR calibration data.

TABLE 9-1
HCMR
MEASURED VALUE NOISE, NEΔT OR S/N RATIO

B.P. TEMP °C	IR SCENE TEMP				DAYLIGHT	
	67°C		-13°C		100% ALBEDO	
	MV-RMS	NEΔT(K)	MV-RMS	NEΔT(K)	MV-RMS	S/N AT 1% Al
+45°	13.0	.15	8.3	.18	8.3	7.2
+40°	11.5	.13	7.0	.13	8.0	7.5
+35	13.3	.15	8.3	.16	8.3	7.2
+30	14.0	.15	9.0	.155	8.3	7.2
+25	15.8	.17	12.5	.21	8.3	7.2
+20	15.0	.16	11.5	.22	7.0	8.6
+15	15.0	.16	14.0	.27	8.3	7.2
+10	15.8	.17	15.0	.28	8.3	7.2
+5	16.6	.18	13.3	.25	--	
0	15.0	.17	14.0	.25	--	

TABLE 9-2 HCMR CALIBRATION STEPS

Near IR
Input (Volts)

Step No.	Baseplate Temperatures							
	+5°C	+10°C	+15°C	+20°C	+25°C	+30°C	+35°C	+40°C
1		-0.002	-0.002	0.002	-0.002	0.001	0.007	0.003
2		1.003	1.004	1.006	0.997	1.001	1.006	1.002
3		1.982	1.982	1.986	1.976	1.979	1.986	1.980
4		2.989	2.990	2.989	2.980	2.983	2.989	2.984
5		3.957	3.968	3.967	3.958	3.961	3.967	3.964
6		4.983	4.987	4.983	4.974	4.977	4.984	4.977
7		5.957	5.964	5.962	5.952	5.953	5.962	5.953

Near IR
Output (Volts)

1		0.011	0.002	0.005	0.005	0.002	0.008	0.008
2		0.978	0.969	0.969	0.970	0.969	0.969	0.969
3		1.976	1.967	1.972	1.969	1.966	1.970	1.9687
4		2.951	2.947	2.948	2.947	2.945	2.947	2.945
5		3.958	3.954	3.954	3.956	3.952	3.952	3.954
6		4.934	4.929	4.928	4.929	4.926	4.929	4.927
7		5.928	5.926	5.924	5.922	5.923	5.925	5.923

IR
Input (Volts)

1	0.102	0.104	0.102	0.104	0.102	0.102	0.101	0.098
2	1.062	1.062	1.060	1.056	1.058	1.057	1.060	1.053
3	1.987	1.991	1.988	1.986	1.991	1.990	1.991	1.988
4	2.945	2.945	2.942	2.940	2.943	2.944	2.946	2.942
5	3.887	3.883	3.874	3.877	3.875	3.875	3.875	3.873
6	4.855	4.852	4.848	4.842	4.847	4.849	4.852	4.843
7	5.789	5.783	5.778	5.778	5.780	5.783	5.783	5.777

IR
Output (Volts)

1	0.012	0.008	0.007	0.010	0.011	0.008	0.007	0.010
2	0.975	0.970	0.966	0.969	0.969	.969	0.966	0.968
3	1.966	1.964	1.964	1.962	1.962	1.962	1.961	1.960
4	2.940	2.938	2.936	2.935	2.938	2.936	2.936	2.935
5	3.949	3.947	3.947	3.944	3.944	3.944	3.942	3.942
6	4.926	4.922	4.919	4.921	4.919	4.917	4.919	4.914
7	5.921	5.915	5.915	5.914	5.917	5.912	5.913	5.910

TABLE 9-3 ANALOG TM DATA

Digital TM No.	Analog TM No.	Function	Baseplate Temperatures							
			+5°C	+10°C	+15°C	+20°C	+25°C	+30°C	+35°C	+40°C
	1	Electronics Temp (°C)	5.9	9.0	12.2	14.7	17.7	20.8	24.0	27.1
	2	Cone Temperature (K)	161.3	161.71	162.05	162.36	162.70	163.1	163.41	164.05
	3	Baseplate Temperature (°C)	+5.5	11.0	15.6	20.0	24.6	29.5	34.1	39.5
	4	Blackbody Temp #1 (°C)	5.91	10.79	14.93	18.86	23.08	27.15	31.28	35.88
	5	Blackbody Temp #2 (°C)	5.86	10.79	14.98	18.94	23.18	27.27	31.42	36.05
	6	Patch Temperature (K)	115.49	115.51	115.53	115.55	115.56	115.58	115.61	115.63
	7	Motor Drive Current (Amps)	0.297	0.293	0.286	0.282	0.276	0.269	0.264	0.258
	8	+15 Volt Monitor +V	+14.67							+14.67
	9	-15 Volt Monitor (-V)	-13.56							-13.56
	10	+5 Volt Monitor (+V)	+5.094	5.092	5.092	5.090	5.090	5.088	5.086	5.084
	11	Spare								
	12	Preamp Power TM (+V)	10.9							10.09
	13	Telemetry Power (+V)	14.81							14.81
	14	Cone Cover Pos (Deg)	10.4							10.4
	15	Patch Power (MW)	7.53	7.24	7.00	6.77	6.50	6.28	5.97	5.64
	16	Cooler Hsg Temp (°C)	-6.5	-5.5	-4.5	-4.5	-3.0	-2.5	- .7	0
	17	Purge Pressure (Psig)	87							87
	18	Electronic Current (+Amps)	.394							.394

TABLE 9-3 ANALOG TM DATA (Continued)

Digital TM No.	Analog TM No.	Function	Baseplate Temperatures							
			+5°C	+10°C	+15°C	+20°C	+25°C	+30°C	+35°C	+40°C
	19	Signal Ground								
	20	Sig. Gnd								
	21	Motor Hsg. Temp (°C)	+6	+11	+15	+19	+23.3	+27.5	+31.5	36.3
	22	+28V Return								
	23	Offset Voltage (V)	7.54							7.54
	24	Comp. Mot. Spd. Telm(RPM)	4794	4794	4794	4794	4823	4823	4823	4823
	25	Scan Mot. Spd. Telm(RPM)	839.9							839.9

TABLE 9-4 IR ANALOG CALIBRATION DATA

INST. BASEPLATE TEMP. (°C)	BASEPLATE TEMP 0°C		BASEPLATE TEMP +5°C		BASEPLATE TEMP +10°C		BASEPLATE TEMP +15°C	
Nom Target Temp K	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts
260	-12.92	.1240	-13.10	.1009	-12.95	.0964	-12.93	.0879
265	-8.02	.3925	-7.94	.3779	-8.95	.3590	-8.03	.3514
270	-2.91	.6753	-3.07	.6534	-2.96	.6390	-2.97	.6246
275	+1.94	.9657	2.05	.9496	+2.20	.9423	+2.12	.9249
280	7.85	1.3337	7.06	1.2620	7.18	1.2477	7.04	1.2286
285	12.20	1.6143	12.05	1.5856	12.08	1.5667	12.32	1.5564
290	17.00	1.9482	17.07	1.9264	17.05	1.9019	17.08	1.8904
295	22.04	2.3051	22.06	2.2822	22.05	2.2531	22.10	2.2458
300	27.14	2.6792	27.87	2.7063	27.10	2.6214	26.88	2.5855
305	32.05	3.0451	32.09	3.0275	31.96	2.9913	32.10	2.9815
310	37.04	3.4368	37.00	3.4172	36.97	3.3774	37.00	3.3657
315	42.01	3.8459	42.10	3.8200	42.04	3.7864	42.06	3.7650
320	47.08	4.2723	46.97	4.2357	47.04	4.2054	47.02	4.1778
325	52.01	4.7009	52.03	4.6678	51.96	4.6276	52.05	4.6052
330	56.36	5.1583	57.05	5.1025	57.07	5.0684	57.07	5.0442
335	61.98	5.5881	62.08	5.5672	62.01	5.5194	62.07	5.4921
340	67.14	6.0704	67.03	6.0255	66.97	5.9810	66.95	5.9459

TABLE 9-4 IR ANALOG CALIBRATION DATA

INST. BASEPLATE TEMP. (°C)	BASEPLATE TEMP +20°C		BASEPLATE TEMP +25°C		BASEPLATE TEMP +30°C		BASEPLATE TEMP +35°C	
Nom Target Temp K	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts
260	-13.00	.0675	-13.01	.0543	-13.02	.0357	12.85	.0229
265	-8.01	.3331	-8.00	.3155	-8.01	.2965	-8.00	.2818
270	-2.98	.6085	-2.80	.5926	-2.95	.5752	-2.92	.5607
275	+2.09	.9046	+2.18	.8927	+2.16	.8695	+2.27	.8580
280	7.17	1.2168	7.15	1.2008	7.16	1.1762	7.17	1.1575
285	12.14	1.5361	12.16	1.5230	12.14	1.4968	12.15	1.4736
290	17.09	1.8640	17.10	1.8438	17.05	1.8176	17.04	1.7930
295	22.17	2.2207	22.16	2.1968	22.19	2.1673	22.03	2.1382
300	27.06	2.5721	27.03	2.5400	27.18	2.5266	27.11	2.5034
305	32.03	2.9481	31.99	2.9171	32.05	2.8972	31.97	2.8559
310	36.98	3.3280	37.02	3.3016	36.97	3.2690	36.90	3.2375
315	42.06	3.7301	42.08	3.7043	42.08	3.6832	42.02	3.6427
320	47.15	4.1601	47.12	4.1249	47.20	4.0924	47.16	4.0565
325	52.05	4.5735	52.09	4.5471	52.10	4.5002	52.04	4.4629
330	57.08	5.0080	57.08	4.9698	57.04	4.9229	57.12	4.8987
335	62.09	5.4616	62.10	5.4251	62.05	5.3750	62.04	5.3314
340	67.02	5.9116	67.06	5.8765	67.00	5.8231	67.06	5.7887

TABLE 9-4 IR ANALOG CALIBRATION DATA

INST. BASEPLATE TEMP. (°C)	BASEPLATE TEMP 40°C		BASEPLATE TEMP 45°C		BASEPLATE TEMP		BASEPLATE TEMP	
Nom Target Temp K	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts	AVG Cal Tgt Temp	IR Signal Volts
260	-13.14	-.0006	-11.88	.0357				
265	-7.99	.2573	-7.99	.2369				
270	-2.97	.5287	-2.98	.5084				
275	+2.12	.8201	+2.10	.7925				
280	7.05	1.1138	7.11	1.0906				
285	12.12	1.4375	12.17	1.4090				
290	17.03	1.7553	17.23	1.7365				
295	22.13	2.1051	22.21	2.0730				
300	27.15	2.4561	27.15	2.4284				
305	32.11	2.8181	32.06	2.7800				
310	37.01	3.1917	37.20	3.1687				
315	42.08	3.5879	42.07	3.5366				
320	47.15	3.9973	47.18	3.9500				
325	52.22	4.4196	52.12	4.3617				
330	57.10	4.8361	56.93	4.7803				
335	62.11	5.2758	62.16	5.2211				
340	67.01	5.7119	67.05	5.6535				

TABLE 9-5 SIGNAL VOLTS FOR 0 - 45° BASEPLATE TEMPERATURE

Target Temp. °K	0	5.0	10.0	15.0	20.0	25.0
26Ø.ØØ1 Volts =	.1Ø9114	.1Ø2ØØ9	8.8661ØE-Ø2	7.79431E-Ø2	6.19214E-Ø2	4.7ØØ44E-Ø2
264.999	.386884	.368726	.353Ø46	.342432	.326148	.3Ø915
269.999	.673624	.649Ø46	.63Ø955	.62Ø255	.6Ø319	.584757
275.ØØ1	.97Ø384	.943516	.923374	.912272	.8938Ø9	.873991
279.999	1.278Ø9	1.25258	1.23Ø41	1.21863	1.19852	1.17741
285.ØØ1	1.59842	1.57645	1.5524	1.53965	1.51734	1.49519
289.999	1.93237	1.91517	1.8892	1.87536	1.85Ø74	1.82756
294.999	2.28162	2.26831	2.24Ø71	2.22547	2.19853	2.17433
3ØØ.	2.64747	2.63533	2.6Ø6Ø4	2.58941	2.56Ø33	2.53484
3Ø5.	3.Ø3Ø75	3.Ø1547	2.98465	2.9667	2.93575	2.9Ø873
31Ø.ØØ1	3.43219	3.4Ø8Ø5	3.37562	3.35626	3.324Ø7	3.29498
315.	3.85Ø9	3.81224	3.778Ø2	3.75743	3.72437	3.6931
32Ø.	4.28477	4.22738	4.19145	4.16974	4.13637	4.1Ø247
325.	4.72952	4.65351	4.61617	4.59292	4.55929	4.52299
33Ø.	5.17858	5.Ø9153	5.Ø53Ø9	5.Ø2794	4.99359	4.955Ø7
334.999	5.62382	5.54325	5.5Ø453	5.47625	5.43989	5.4ØØ21
34Ø. Volts =	6.Ø5712	6.Ø1212	5.97467	5.94129	5.9ØØ25	5.86158

TABLE 9-5 SIGNAL VOLTS FOR 0 - 45° BASEPLATE TEMPERATURE

Target Temp. °K	30.0	35.0	40.0	45.0		
26Ø.ØØ1 Volts =	3.19531E-Ø2	1.Ø6213E-Ø2	7.65882E-Ø2	1.Ø6738E-Ø2		
264.999	.2932Ø8	2.7367	.255756	.231275		
269.999	.567851	.549455	.524992	.5Ø1628		
275.ØØ1	.856181	.838347	.8Ø8Ø3	.784538		
279.999	1.15851	1.14Ø47	1.1Ø5Ø3	1.Ø8Ø91		
285.ØØ1	1.47515	1.45648	1.41672	1.39Ø76		
289.999	1.8Ø594	1.78614	1.74274	1.71467		
294.999	2.15Ø79	2.12937	2.Ø8329	2.Ø5244		
3ØØ.	2.5Ø905	2.48611	2.43769	2.4Ø389		
3Ø5.	2.88Ø41	2.85558	2.8Ø513	2.76884		
31Ø.ØØ1	3.264Ø2	3.23751	3.18513	3.14638		
315.	3.659Ø2	3.631Ø2	3.5767	3.53611		
32Ø.	4.Ø6524	4.Ø3573	3.979Ø4	3.9369		
325.	4.48257	4.45167	4.3919	4.3481		
33Ø.	4.91173	4.87911	4.81578	4.76942		
334.999	5.35431	5.31898	5.25186	5.2ØØ62		
34Ø. Volts =	5.81367	5.77356	5.7Ø262	5.64223		

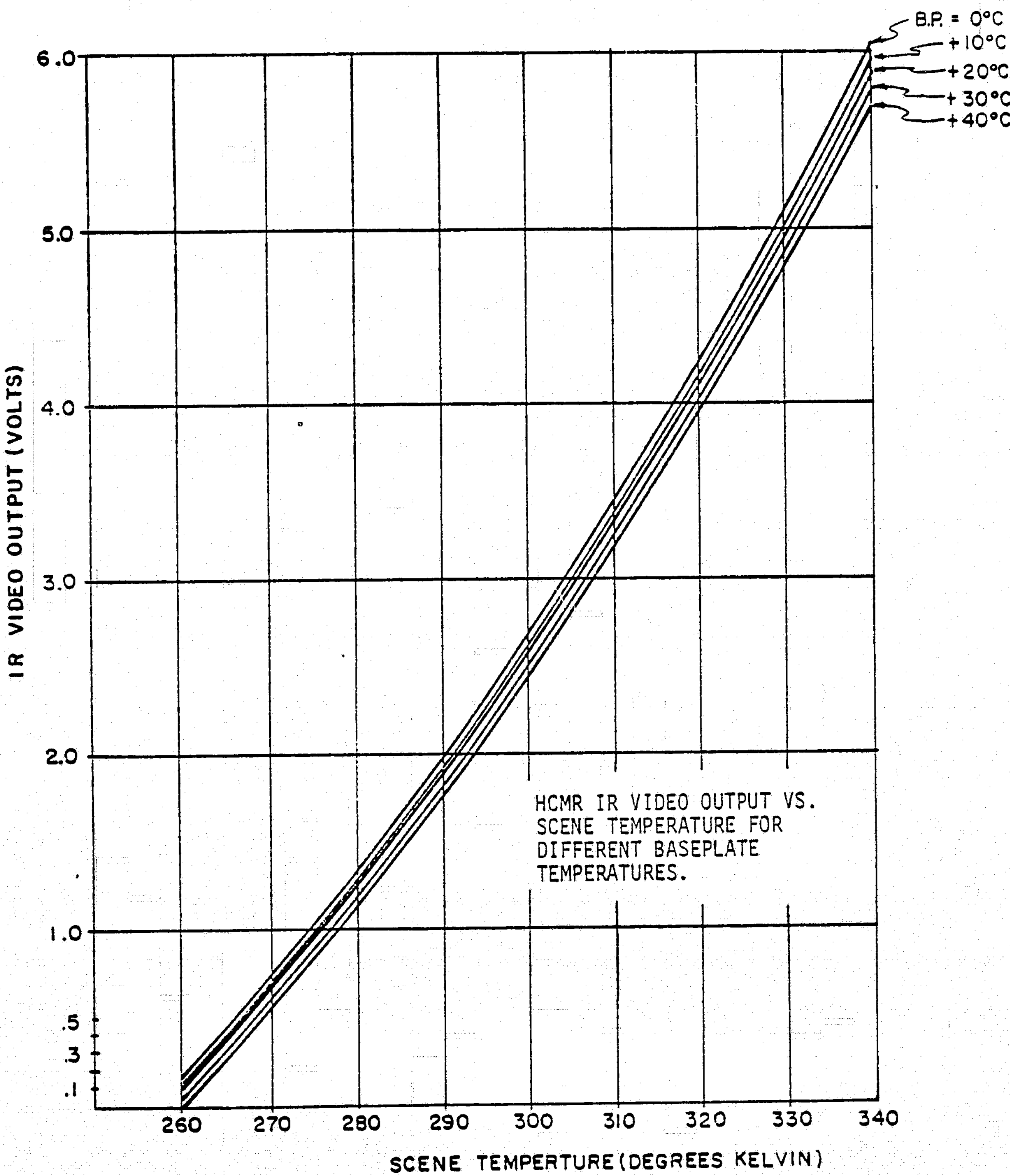

B.P. = 0°C
+10°C
+20°C
+30°C
+40°C
6.0
5.0
4.0
3.0
2.0
1.0
.5
.3
.1
IR VIDEO OUTPUT (VOLTS)
HCMR IR VIDEO OUTPUT VS. SCENE TEMPERATURE FOR DIFFERENT BASEPLATE TEMPERATURES.
260
270
280
290
300
310
320
330
340
SCENE TEMPERTURE (DEGREES KELVIN)

FIGURE 9-1

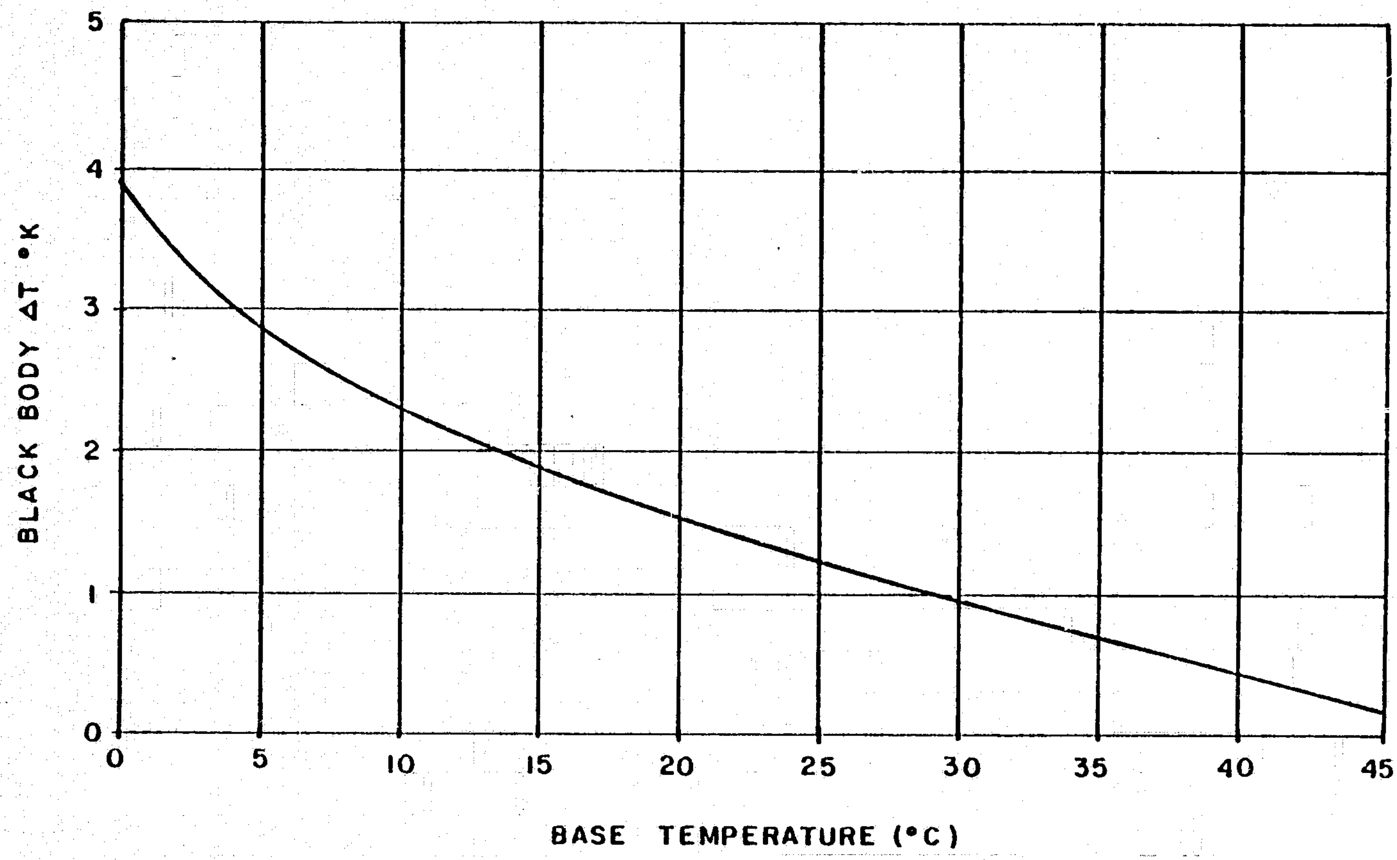


FIGURE 9-2 AVERAGE DIFFERENCE BETWEEN BBTM FROM SIGNAL LINE AND BB TEMP READ FROM SIGNAL

TABLE 9-6 HCMR IF OV & REGISTRATION DATA

0°C BASEPLATE

IFOV

Bench Test Near IR		IR	
Scan Direction	No Data	Scan Direction	No Data
Cross Scan Direction	No Data	Cross Scan Direction	No Data

Chamber 1 ± FOV Target

Scan Direction	1.16MRad	Scan Direction	1.50 MRad
Cross Scan Direction	1.075MRad	Cross Scan Direction	1.30 MRad

REGISTRATION

Near IR	IR
Scan Direction	Cross Scan Direction
.026 MRad	.063 MRad

MTF AT IFOV TARGET

Near IR	IR
55%	38%

TABLE 9-6 HCMR IFOV & REGISTRATION DATA (CONT.)

45°C BASEPLATE

IFOV

Bench Test

Near IR		IR	
Scan Direction	No Data	Scan Direction	No Data
Cross Scan Direction	No Data	Cross Scan Direction	No Data

Chamber 1 ± FOV Target

Near IR		IR	
Scan Direction	1.16MRad	Scan Direction	1.40 MRad
Cross Scan Direction	1.28MRad	Cross Scan Direction	1.45 MRad

REGISTRATION

Near IR	IR
Scan Direction	Cross Scan Direction
.1 MRad	0 MRad

MTF AT IFOV TARGET

Near IR	IR
56%	46%

TABLE 9-6 HCMR IF OV & REGISTRATION DATA (CONT.)

25°C BASEPLATE

IFOV

BENCH TEST

NEAR IR		IR	
SCAN DIRECTION	.837MR	SCAN DIRECTION	.99MR
CROSS SCAN DIRECTION	.86MR	CROSS SCAN DIRECTION	.97MR

CHAMBER 1 ± FOV TARGET

NEAR IR		IR	
SCAN DIRECTION	1.05MRAD	SCAN DIRECTION	1.27 MRAD
CROSS SCAN DIRECTION	1.08MRAD	CROSS SCAN DIRECTION	1.36 MRAD

REGISTRATION

NEAR IR	IR
SCAN DIRECTION	CROSS SCAN DIRECTION
.083MRAD	.032 MRAD

MTF AT IFOV TARGET

NEAR IR	IR
50%	35%

TABLE 9-7 NEAR IR CALIBRATION

NUMBER OF LAMPS ON*	EQUIVALENT ALBEDO	NIR OUTPUT (VOLTS)
8	102.3	6.0890
7	89.3	5.3186
6	76.2	4.5534
5	63.6	3.7870
4	51.4	3.0438
3	38.1	2.2546
2	25.1	1.4869
1	12.3	0.7235
0	0	0.0194

*GSFC 30-inch Integration Sphere Number 61400-6-7

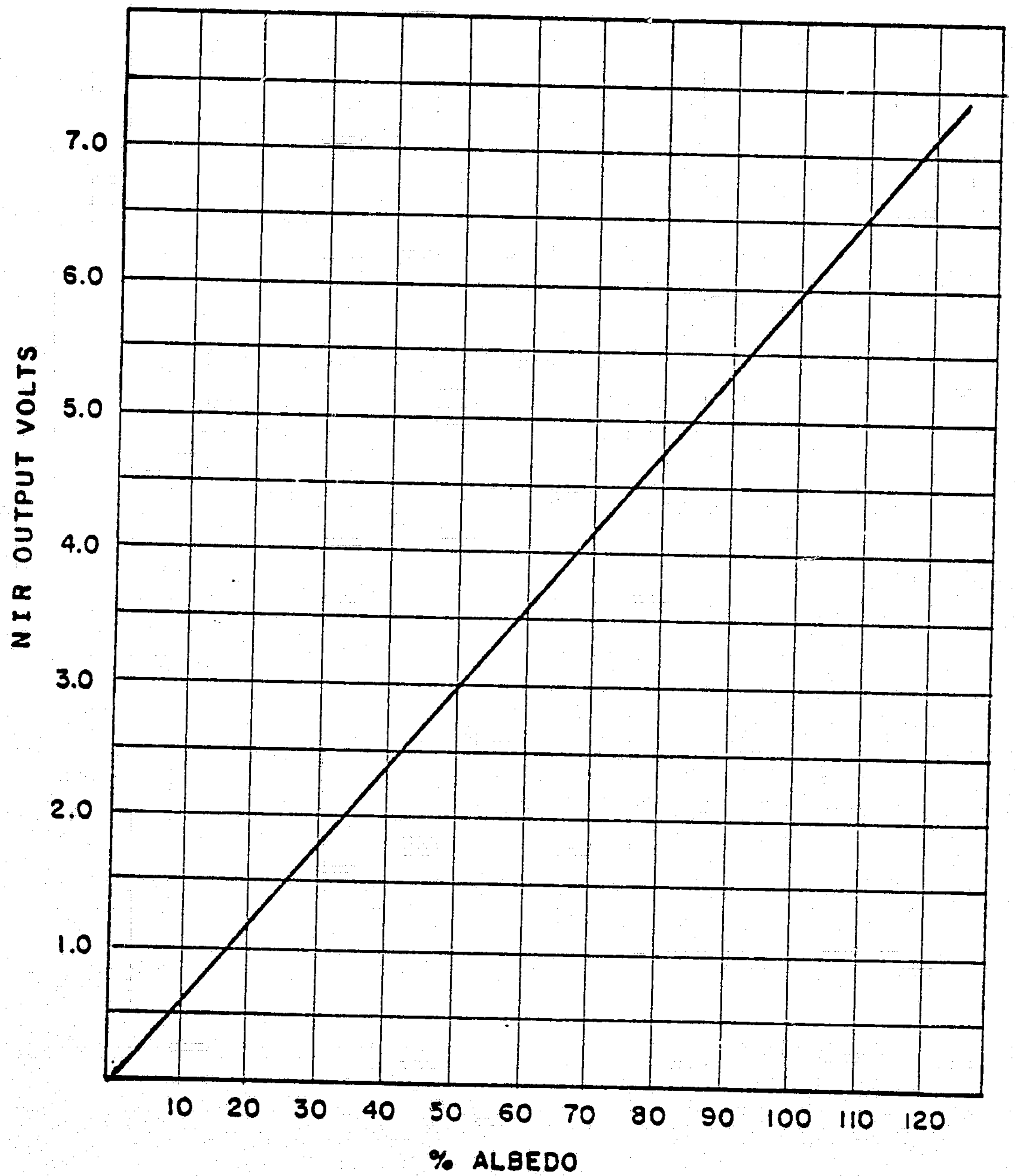


FIGURE 9-3 NEAR IR CALIBRATION